THE

ELECTRICAL REVIEW.

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THE

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SPEEDS OF ATLANTIC CABLES.

THE table of figures giving the speeds of transmission over different Atlantic cables, published in our issue of June 3rd, has attracted a good deal of attention. The principal feature of the table is a comparison of the speeds of the two 1894 cables laid by Messrs. Siemens Bros., and the Telegraph Construction and Maintenance Company respectively. The Mackay-Bennett cable laid by the former, with a K R of 4·671, has a speed of 40 words per minute, and the Anglo-American cable, with a K R of 2·42, has a speed of 47·4 words per minute. That is to say, the speed obtained on the Siemens cable, making allowance for its higher K R, is 63 per cent. greater than on the Anglo-American cable. This figure, sufficiently startling in itself, is still more so if closely examined. The small undulations of the syphon trace, working at 45 words a minute, correspond to those of an alternating current of about 17 ~ per second, and at 75 words a minute to about 28 ~ per second. The amplitude of alternating signals received at the rate of 17 ~ per second over a cable having a K R of 2·42 is 13·6 times as great as the amplitude when received at the rate of 28 ~ per second, the amplitude of the sent signals, or, in other words, the alternating E.M.F. employed, being the same in both cases. The expressions from which this figure is calculated were given in our Vol. 41, p. 191. Column 10 of the table we are referring to gives a comparison of the efficiencies of the Mackay-Bennett and Anglo-American cables as 77·2 to 47·4, which we have taken as 75 to 45 in round figures; which implies that a cable manufactured by Messrs. Siemens Bros., of the same dimensions as the Anglo-American, would transmit alternations with 13·6 times the amplitude of those transmitted by the actual cable laid by the Telegraph Construction and Maintenance Company. This comparison of the cables has no meaning, unless the terminal arrangements of the two are similar or equivalent, and in which case we have to meet an assertion that of two cables similar in all respects, and having the same electrical constants, one transmits an alternating current 13·6 times as well as the other. If this can be established, the accepted theory of cable transmission has to go, and with it column 10, which is calculated on the assumption of the K R law. But the explanation must be looked for in the arrangements at the terminal stations, and it would be interesting to know how, with the apparatus in ordinary use, such a marked improvement is obtained. An improvement, however, of much more than 60 per cent. in speed over the syphon recorder is probably attainable in simplex working by using a photographic recording slip and a mirror. The principal impressions we draw from the table are the difficulty of comparing the working speed efficiencies of cables, when so much difference exists between the practice of two neighbouring stations as regards the kinds of instruments used, and the methods of transmitting and receiving signals. We are not aware to

what degree of exactness the accepted law of electrical propagation has been verified, but it is hardly possible that there can be any serious error in it.

On Electrolytic Corrosion of Gas and Water Mains at Glasgow.

Mr. Chamen has made a report to the Gas and Water Departments of the Glasgow Corporation on prevention of electrolysis of the gas and water mains along the Springburn electric tramway route. Mr. Chamen found the electrical resistance of the steel rails to be about ten times that of copper, or in actual figures the resistance of 42 feet of rail is ·0003575 of an ohm. The sectional area of the rail is 10 inches. The resistance of the copper bonds, including the points of junction or contact with the rails, measured with two bonds in parallel, as they are actually being laid, averages ·000066 of an ohm. The length of the line from Springburn to Mitchell Street is about 13,400 feet. With 20 cars running on this route taking each an average current of 25 amperes, Mr. Chamen estimates that the return current in the section of the line nearest the power station will be 400 amperes. The greatest fall of potential between one terminus and the power station he estimates at 5·56 volts. This is well within the Board of Trade limit of 7 volts, and the tramway department do not, therefore, intend to put in return feeders. Mr. Chamen thinks, that with good bonding of the rails, there will be no fear whatever of electrolysis of gas or water mains. We doubt whether, under all conditions, this decision would be safe. Though the Board of Trade limit of 7 volts may nowhere be exceeded, the steepness of the potential gradient at some point along the line may be such as to imply a much greater total P.D. than 7 volts. For instance, in this case the return current of 400 amperes in the home section of the line implies a P.D. of more than 11 volts. With a return current of 400 amperes, as much as 100 to 200 amperes may flow through gas and water pipes situated in the neighbourhood of the line. A current of 100 amperes flowing through even a small section of a pipe system should not, we think, be regarded by the gas and water departments of the Glasgow Corporation with equanimity. If the nature of the soil is favourable very little harm may be done for many years, but, on the other hand, if the conditions are unfavourable the gas and water pipes may be rapidly corroded at joints, or at the place of exit of the current. The use of the insulated return feeder, with supplementary E.M.F., which has already been so successfully applied, would obviate all these risks, and considering only the data given in Mr. Chamen's report, we are somewhat surprised to find that he is of opinion that no return feeder is necessary.

An Electrical Gear for Motor Cars.

The *Western Electrician* of Chicago, of May 14th, published an account of a proposal by William Morrison, "the Chicago inventor," for driving motor cars and similar purposes, which is interesting and suggestive. The prime motor, a 4 H.P. gasoline or oil engine, drives directly, and at a constant speed, the field magnet system of a small 4-pole dynamo built in a circular form, and enclosed in a cylindrical case of gun-metal. The armature of the dynamo is connected to the driving gear of the vehicle. Thus the field magnet system and the brushes revolve at a constant speed, 600 revolutions per minute, while the armature revolves at a speed proportional to that at which the carriage is travelling, and in the same sense as the field magnets. Access is obtained to the dynamo circuit by contact rings and brushes, so that regulating resistances can be inserted. The only connection between the engine and the wheels of the carriage is the action between the field magnets and the armature, producing a torque on the axis of the latter; and this torque depends partly on the excess of the speed of the field magnets over that of the armature, and partly on the resistance inserted in the dynamo circuit. When the carriage is at rest, or just starting, so that the armature is at rest, the difference in speed between the field magnets and the armature has its greatest possible value, and the arrangement is then most favourable for producing a large starting torque, while the torque is under complete control at all speeds by means of a rheostat in the dynamo circuit. The speed of the oil engine is maintained nearly constant by means of a governor regulating the admission of oil. So far as it is possible to form an opinion of such an arrangement without practical experience of it, the principle of action greatly commends itself. The insertion of an electrical link between the prime mover and the wheels of a motor car, giving flexibility and simplicity of regulation at the expense of a certain loss of efficiency is the idea of the Heilmann locomotive, but Mr. Morrison's arrangement is by far the simpler and more ingenious of the two, and appears to be well suited to its object. No system of mechanical gears for different speeds seems comparable to it in simplicity, while it allows an engine running constantly at full speed to be thrown into and out of gear with the carriage without shock or jerk of any kind, and without any movement of mechanical parts beyond those of the switch required to break or make the dynamo circuit. No description is given of the connection of the dynamo armature to the wheels of the carriage, but evidently some reversing gear is required. The article in the *Western Electrician* is illustrated, and shows the construction of the dynamo clearly.

Cheating the Cabbages.

Readers of the *Westminster Budget* may remember an article bearing this title which appeared a short time ago, in which an experiment in plant growing under the influence of electricity rays was popularly if not very accurately described. There is no doubt that in America, France, Russia, and other countries, much more attention has been given to the investigation of the effects of electricity on plant culture than in our own country, and though many inconsequent experiments have been carried out and made much of, our knowledge of the subject is certainly the richer for them. At the present moment an important experiment is being carried out in Finland by Prof. Lemstrom, of the University of Helsingfors, with a view to determining the influence of atmospheric electricity upon plant life. Prof. Bailey, of Cornell University, is, we understand, advising with Prof. Lemstrom in this investigation, which, we may say, has been suggested by the observations that in northern regions vegetation is very rapid, and this rapidity may be determined by atmospheric electricity to which it is contended the aurora borealis is due. Although in this country we have not paid much attention to the subject, it has recently been proposed to utilise the Cabot Tower, which is in course of erection on Brandon Hill, Bristol. The land around consists of about 20 acres, is uncultivated, and appears to be well situated for the purpose of experiments. The proposition is to collect atmospheric electricity, and to pass it into certain trial gardens in which plants shall be grown. For this purpose instead of fitting the lightning rod of the Tower with a single point, it is proposed to give it a crown of points. It is conceivable that by this method the supplies of electricity, if we may use such an expression, existing in the atmosphere, could be tapped and conducted by means of wires into small plots of ground, where they would end in earth plates. Dr. E. M. Cook, of the Clifton Laboratory, Berkeley Square, has offered to give his services in carrying out a proper scheme of experiments and to make the necessary observations. The cost of these experiments would be very slight, and it is certainly to be hoped that the good citizens of Bristol will be enterprising enough to accept Dr. Cook's offer. Very little accurate knowledge has been obtained concerning the action of electricity upon vegetation, and it seems to us that here is an opportunity for increasing it.

AN EXHIBIT OF THE MOORE VACUUM TUBE LIGHTING.

We have more than once referred to the ingenious system of vacuum tube lighting invented by Mr. D. McFarlan Moore. Mr. Moore's energy and perseverance in overcoming the practical difficulties connected with this new departure in electric lighting has evidently been rewarded by a considerable amount of success, if we are to judge from the unique exhibit at the New York Electrical Exhibition, of which we give an illustration.

Mr. Moore has erected in the Exhibition a model chapel, complete in every detail, in which he shows to perfection the manner in which vacuum tube illumination can be carried out in practice. The front doors are open, and above their arches shine forth in vacuum tube letters the words: "Moore Vacuum Tube Chapel." The vaulted roof is ribbed with veritable arches of light consisting of long curved tubes of glass about 2 inches in diameter, and glowing their entire length with a pure white light. The tube arches spring from pilasters, each capped with a highly-polished specially-designed brass fixture, which may be seen in the figure. At the apex of the chapel ceiling where the tube arches meet, they are joined by a highly-polished decorated brass cylinder bent at its centre. The fixtures supporting the longitudinal tubes at the apex of the ceiling are also seen in the figure.

The church is wired with the Moore three-wire system of vacuum tube lighting; that is, all of the tubes—10 arch and 3 ridge tubes—are connected in parallel between three wires. The common or positive wire extends along the ridge, while each of the two negative wires extends horizontally along the side of the chapel back of the side fixtures, which rest on top of the pilaster caps. The three wires enter the top of a polished cabinet 2 feet by 2 feet 4 inches, which contains all the lighting apparatus, and is situated on one side of the entrance passageway. There also enters this cabinet at the top the three wires connecting with the street service of the Edison Electric Illuminating Company.

It will be remembered that one of the salient points in Mr. Moore's system is the breaking of the current in a vacuum. This he accomplishes by means of a beautifully constructed rotator. Surrounding the rotator proper, which is of glass, 3 inches in diameter, and a foot long, is a Gramme ring, with its highly polished brass mountings, the whole constituting a beautiful piece of practical apparatus.

This apparatus just described is all that is necessary where multiphase currents are available; but in the exhibit the lower compartment of the cabinet contains a small rotary transformer.

According to Mr. Moore, the system, at its present stage of development, has an efficiency about equal to incandescent lighting; but the inventor looks for better results with the improvement of the tubes.

Besides the rotary vacuum break, Mr. Moore has got into commercial shape a vibratory vacuum break. This apparatus will be extensively used for advertising purposes. It can be used either on direct current circuits or alternate current circuits.

There are also many other applications for this system of lighting. For example, the colour of the light, even to the most delicate shades, can be changed simply by changing the degree of vacuum of the tubes, making it the ideal light for special decorative lighting. Another large field is in connection with photography—for photographers have long been longing for a light which could be regulated to a nicety, and thereby give uniform results. At the Electrical Exhibition in 1896, Mr. Moore took instantaneous portraits by his light.

It has long been a matter of expectation as to when and by whom vacuum tube lighting apparatus would first be placed on the market, and the fact that Mr. Moore is now taking orders is extremely interesting, since it is the beginning of a new departure in electrical work, which is destined, without doubt, to have a wide application.

The above account of Mr. Moore's recent achievements in vacuum tube lighting is abstracted from the *Electrical Engineer*, N.Y.

D

A SHORT METHOD FOR DETERMINING TRANSFORMER EFFICIENCY.*

By FREDERICK BEDELL.

That the common method for calculating transformer efficiency is laborious, and liable to error on account of long multiplications and divisions, has been pointed out by Mr. S. E. Johannesen in the *Electrical World*, p. 588, May 14th, 1898. He suggests a method which reduces somewhat the labour and liability to error; but his formula obtains the efficiency from the ratio of two quantities which differ from each other by only a few per cent., and consequently for accuracy each of these quantities must be very accurate and the long division carefully performed. Evidently, if instead of determining the per cent. efficiency direct we do so by determining the per cent. loss and subtracting from 100, the same degree of accuracy in the work will give greater accuracy in the result, and this may be done with less labour.

Let W represent the rated output in watts; let H denote the watts core loss and C the watts copper loss at full load. Let h_2 denote the core loss as per cent. of rated output W; that is, $h_2 = 100$ H/W. Let c_2 denote the full load copper loss as per cent. of rated output W; that is, $c_2 = 100$ C/W. (The subscrip 2 denotes that per cents. are referred to secondary output rather than to primary input.) Thus in a 2-kw. transformer W = 2,000. If the core loss is H = 30 watts the per cent. core loss is $h_2 = 1{\cdot}5$. If the copper loss is C = 48 watts the per cent. copper loss is $c_2 = 2{\cdot}4$.

Let g denote the fraction of full load, as $\frac{3}{4}$, $\frac{1}{2}$, &c. Obviously the per cent. copper loss varies directly as g, being $g\,c_2$ at any load. Thus at one-half load the per cent. copper loss is $\frac{1}{2}\,c_2$. (In watts, the copper loss at half load is one-quarter copper loss at full load.) The core loss in watts being constant, the per cent. core loss is greater as the load is less, being h_2/g at any load. Accordingly at any load g the total loss (t) as per cent. of secondary output is

$$t = g\,c_2 + h_2/g.$$

The total loss as per cent. of primary input is $t - t_2/100$. This must be subtracted from 100 to give the efficiency. Hence

$$\text{Efficiency} = 100 + \frac{t^2}{100} - t$$

To compute the efficiency accurately to four places, it is only necessary to compute t to three places and t^2 to two places. This may be quickly and accurately done by means of the following table:—

Efficiency Computation Table.

c_2 = ... = per cent. full-load copper loss
h_2 = ... = per cent. core loss
} as per cent of rated output.

Fraction of load.	Losses as per cent. of output.			$\frac{t^2}{100}$	Efficiency.
	Copper.	Core.	Total, t.		
$\frac{5}{4}$	$\frac{5}{4}\,c_2$ = ...	$\frac{4}{5}\,h_2$ = ...	...	...	...
1	c_2 = ...	h_2 = ...	...	...	...
$\frac{3}{4}$	$\frac{3}{4}\,c_2$ = ...	$\frac{4}{3}\,h_2$ = ...	...	...	...
$\frac{1}{2}$	$\frac{1}{2}\,c_2$ = ...	$2\,h_2$ = ...	...	...	...
$\frac{1}{4}$	$\frac{1}{4}\,c_2$ = ...	$4\,h_2$ = ...	...	...	...
$\frac{1}{10}$	$\frac{1}{10}\,c_2$ = ...	$10\,h_2$ = ...	...	...	...

$$\text{Efficiency} = 100 + \frac{t^2}{100} - t.$$

The all-day efficiency, if the transformer is x hours on full load each day and on no load the remainder of the time, is

$$\text{all-day efficiency} = \frac{100}{100 + c_2 + (24 \div x)\,h_2}.$$

If the transformer is five hours on full load and 19 hours on no load, the all-day efficiency is

$$\text{all-day efficiency} = \frac{100}{100 + c_2 + 4{\cdot}8\,h_2}.$$

* *Electrical World*, New York.

The facility with which these computations can be made may be seen from the following example:

Example.

2-kw. transformer. Copper loss = 48 watts.
Core loss = 30 watts.

Efficiency Computation Table.

$c_2 = 2{\cdot}4$ = per cent. full load copper loss
$h_2 = 1{\cdot}5$ = per cent. core loss
} as per cent. of rated output.

Fraction of load.	Losses as per cent. of output.			$\frac{t^2}{100}$	Efficiency.
	Copper.	Core.	Total, t.		
$\frac{5}{4}$	$\frac{5}{4}\,c_2 = 3{\cdot}0$	$\frac{4}{5}\,h_2 = 1{\cdot}2$	4·2	·18	95·98
1	$c_2 = 2{\cdot}4$	$h_2 = 1{\cdot}5$	3·9	·15	96·25
$\frac{3}{4}$	$\frac{3}{4}\,c_2 = 1{\cdot}8$	$\frac{4}{3}\,h_2 = 2{\cdot}0$	3·8	·14	96·34
$\frac{1}{2}$	$\frac{1}{2}\,c_2 = 1{\cdot}2$	$2\,h_2 = 3{\cdot}0$	4·2	·18	95·98
$\frac{1}{4}$	$\frac{1}{4}\,c_2 = 6$	$4\,h_2 = 6{\cdot}$	6·6	·44	93·84
$\frac{1}{10}$	$\frac{1}{10}\,c_2 = {\cdot}24$	$10\,h_2 = 15$	15·24	2·32	87·08

$$\text{Efficiency} = 100 + \frac{t^2}{100} - t.$$

$$\text{All-day efficiency} = \frac{100}{100 + c_2 + 4{\cdot}8\,h_2} = 91{\cdot}24.$$

FURTHER BOARD OF TRADE REGULATIONS.

"Coming events cast their shadows before," and in this connection No 5 of the Minutes of the Special Committee on Electrical Energy is particularly interesting, as it contains the examination of Major Cardew on question 957, respecting danger to employés.

With modest hesitation, and only after considerable coaxing, Major Cardew admitted that he had a set of draft regulations for the protection of employés, but he said:—"I am hardly prepared to hand these regulations in; it is some years since I drew them out, and they may not touch every point which has turned up with the experience we have to-day." Nevertheless, they were handed in and, as will be seen in the "definitions," although they may have been originally sketched out several years ago, they have evidently been carefully kept and brought up to date. The title is as follows:—

"Regulations for the protection of employés in electrical supply works and other places wherein electrical energy is generated, regulated, transformed, or connected."

Amongst the "definitions" is to be found that of "high pressure supply," and is the same as that given in the regulations for the safety of the public, viz., anything exceeding 500 volts continuous, or 250 volts alternating.

Clause No. 1.—Provides that all metal work, not forming, or intended to form part of a circuit, whether structural or otherwise, whether in the generating station or sub-station, shall be efficiently connected to earth and to each other; luckily, nails, screws, or small fittings fixed so as to be in contact with dry wood or other non-conducting substance only, are excepted; but as the roof trusses, ties, &c., are not mentioned, we presume they are included as well as the firing irons and coal bunker doors!

No. 2 requires all high-pressure conductors to be completely enclosed in a tube of highly insulating material properly protected, or in earthed metal casing—this to be done as far as is consistent with the intended use of the conductor. Concentric mains with earthed outer are exempted.

No. 3.—Where it is not possible to entirely enclose such conductors, this clause provides that they shall be properly guarded, so as to prevent accidental contact, and shall also be conspicuously marked as dangerous by being labelled or painted red, and no such conductors shall be fixed within 3 feet of a doorway or other access to the generating station or sub-station. In the event of these rules being adopted and being retrospective, this clause will necessitate increasing the dimensions of a large number of sub-stations, and so abolishing what are now little better than man traps.

No. 4 requires an insulated floor or platform around switchboards, &c., and is a reasonable and proper precaution; but to so arrange the floor or platform that the attendant, when standing upon it, cannot possibly make accidental contact with earth, is a more difficult matter, and in some cases practically impossible.

No. 5 deals with switchboards, and states that they must be formed of highly insulating and incombustible material. We presume this refers to the bases of the switches or facing of the board, and not to the frame upon which they are erected, and is in this case a reasonable requirement. Connections must be made in front of the board, or, if taken behind a passage, at least 4 feet wide must be left, and the doors leading thereto must be kept locked, the key being in the charge of the chief engineer or other responsible person. The next paragraph is as follows:—"All leads and connections between which any difference of electrical potential greater than 5 (five) volts may exist must be easily distinguishable by position, colour, or other distinctive mark." We have tried to imagine what this is all about, but, in the absence of any explanation, we can only presume that it has something to do with fire risk, and refers to low tension stations. The last paragraph of this clause requires that adequate means shall be provided to enable an employé to ascertain when all electrical pressure has been removed from all metal he may be required to examine, clean, or alter. Very good.

No. 6. *Instruments.*—This clause will, we venture to say, raise some opposition on the part of station engineers, and is, to put it mildly, absurd!

"All instruments used, or intended (!) to be used, for measuring or indicating electric energy, current, or pressure, within any generating station or sub-station, shall be of suitable pattern and construction *and accurate in their readings within an error of 2½ per cent. at any point of their range*, in terms of the electrical standards deposited at the Board of Trade Standardising Laboratory; *and such accuracy must be constantly maintained.*" (The italics are ours.) This is simply Governmental regulation gone mad! and if enforced, would probably result in the scrapping of 99 per cent. of all the station switchboard instruments in existence. What on earth can be the object of such a regulation, and how can it possibly affect the safety of the staff either one way or the other! As we have said, the thing is absurd and could not be seriously entertained by anybody with reasonable intelligence, and after thinking the matter carefully over. It must be always remembered that these draft regulations are avowedly intended to protect the lives of the staff, and although our condemnation of the last regulation is strong, we think it quite justified until it can be shown that an error of, say, 3 per cent. in the reading of an ammeter, is going to jeopardise the lives and safety of anybody; even an error of 20 per cent. in a voltmeter could not do so, the idea is sheer nonsense. Surely any serious error in indicating or recording instruments would be corrected by the station engineer without any regulations; but, in any case, we fail to see in what manner it concerns the Board of Trade.

After the momentary mental aberration shown in the drafting of the last clause, it is with considerable satisfaction that we note *Regulation* 7, which provides that all generating and sub-stations shall be adequately illuminated, especially where attention is required to any high tension machinery, apparatus, or instruments. Not more than 50 per cent. of the total artificial illumination shall be supplied by the running machinery in the station, or from the mains, in case of sub-stations. This is very good indeed, so far as it goes, but the spirit of the clause, although obvious, could be evaded by lighting the works from storage batteries or similar source, quite independent of the running plant. Far better that the regulation should provide that the illumination be divided into two parts, each being supplied from separate and independent sources, so that in the event of the temporary failure of one part the station would not be left in darkness. As regards sub-stations, the provision of candles and matches as required in the regulation would suffice in addition to electric lighting from the mains.

No. 8 requires that when work other than switching, &c., is being executed in sub-stations, all high pressure mains and plant shall be discharged of electrical pressure or efficiently screened. Perfectly right.

No. 9 requires that rubber gloves shall be provided and kept in good condition; this is obviously necessary, and we should hope universally adopted.

No. 10 provides that printed instructions for dealing with persons in case of electric shock shall be conspicuously exhibited in the station, which, we believe, is now the general rule.

No. 11, and last, should be unnecessary, and we think would somewhat complicate the arrangement of shifts, while it would undoubtedly meet with strong opposition from those in whose interest the regulation is drafted. We give it in full.

"No employé in any generating station or sub-station shall be required to remain on any duty connected with the regulation of high pressure supply for more than four hours consecutively, or for more than eight hours in any day; and no employé shall be allowed to take over such duty until he has been inspected by an engineer or other competent official as to his fitness to undertake such duty."

As the regulation stands, a switchman or electrician may be required to work four hours, say, from 8 p.m. to 12 midnight, to go off duty until 4 a.m., and then to resume duty until 8 a.m. Without doubt he would much rather work eight hours, and then go off for 16 hours, as is now usual, and we do not think "the engineer, or other competent official," would care to become a sort of medical officer.

Taking the regulations as a whole, they are, with the exceptions noted, very reasonable; but they seem to be somewhat familiar, and we believe several of them were suggested by the committee appointed by the Home Office, whose draft regulations, by the way, seem to have been forgotten. The question is whether such regulations, dealing with the staff, should not be left to the Home Office; but in any case two sets are not required.

The report of the Select Committee on Electrical Energy ignores these rules altogether, and they must be looked for in a special Bill, which will probably be promoted by the Board of Trade, as the outcome of the inquiry.

ELECTRIC TRACTION.

THE paper presented to the Municipal Electrical Association by Mr. R. C. Quin can hardly be said to contribute anything new to the common stock of knowledge on electric traction.

We were unaware that there was any considerable difference of opinion as to whether the rails should be 43 lbs. per yard or 92 lbs. per yard when electric tramcars are used. Considering the greater weight of electric tramcars, the maintenance of the bonding and the joints, there can be no doubt but that rails of at least 90 lbs. per yard are best suited for electric traction under ordinary municipal conditions.

In dealing with the subject of rails, we should have appreciated a discussion on the present rules of the Board of Trade limiting the width of the groove. In other countries a wider groove has been satisfactorily used, and better wear of the car wheels realised.

The mechanical construction of the rail joint is a matter that will stand a great deal of discussion, and traction engineers the world over seem undecided as to the best form of rail joint, this being the weakest part in electric permanent way construction.

The electric welding of the joints has not been entirely satisfactory. The nearest approach to a satisfactory rail joint is the Falk joint, and it does not seem improbable that a cast joint of this type will, sooner or later, come into general use in England. The advantages of a perfect rail joint are two-fold; first, that the mechanical construction becomes perfect, and secondly, the bond, no matter of what type, will be found more durable, on account of the greater rigidity of the joint.

The explanation of the type of rail joint used at Hamburg is not clear. We judge, however, it would be objected to by many traction engineers, since from what we gather of the description, the joint would be difficult to handle where rails have to be cut into unequal lengths.

We are unable to understand Mr. Quin's reasoning as to generators and fly-wheels. That there is considerable inertia in the car there can be no doubt, but this inertia is to be

overcome by the prime mover. In the case of engines, the available force to overcome the inertia is the force exerted by the steam against the piston and the fly-wheel effect. If the steam cylinders are given sufficient capacity for doing the maximum that may occur by several cars starting at once, then they must be excessively large compared with the average load on the engine, which in traction work would not ordinarily be much beyond one-third of the maximum work to be done momentarily. Obviously, then, the only way to economically get the force required for momentarily overloading is by means of heavy fly-wheels. This agrees with practical experience, since engines have frequently failed to be satisfactory for electric traction until they have been equipped with heavier fly-wheels, and with heavy fly-wheels practice has fully demonstrated that the cylinders may be smaller, and consequently an economic gain under average working.

We do not understand why uniform E.M.F. in the line is not conducive to a uniform speed of the tramcars. Certainly the speed of an electric motor exerting a given horizontal effort varies directly with the E.M.F. at its terminals. There can be no doubt that in a system having practically constant voltage, the consumption of energy by the cars will be less than one having a varying voltage.

Further, constancy in voltage is important to secure good lighting of the cars in the night time. It is a most disagreeable sensation to see the lights go down when the cars start.

There has been much discussion as to the comparative values for quick and slow speed engines for traction purposes. Undoubtedly, in smaller sizes, the moderately quick speed engine has decided advantages as to cost over the Corliss or slow speed engine, but in the case of large machines there can be no doubt that the slow speed machinery will be found more efficient and more economical to maintain. That quick speed engines have been built beyond a proper size is sufficiently illustrated by a recent test on most approved high speed engines, and in which a 700 H.P. machine was found to have a mechanical efficiency of less than 85 per cent., whereas a Corliss engine of the same output, and with 90 or 100 revolutions, would have had a mechanical efficiency of 92 per cent. The best records of steam consumption so far published have been accomplished by slow speed engines, having very moderate piston speed.

In the discussion of motors there remains much to be said as to rating. A leading American firm in electric traction gave the capacity of a motor in terms of the horizontal effort at a given number of miles per hour. The motor was supposed to give a corresponding output for two hours, no part heating more than 50° C. We think such a method of rating if standardised would be most convenient. Owing, however, to the methods not coming into general use, it has been abandoned by those who established it from commercial considerations. It seems the great desideratum in connection with traction motors is to get the widest possible range of load at high efficiency. More recently, advances have been made in this direction by lessening the fixed loss due to hysteresis and eddy currents in the armature core, the amount of iron has been diminished and the amount of saturation correspondingly increased. It has been found that under average load the core loss is much smaller than in the case of a non-saturated armature, the effect upon sparking by greatly increasing the magnetisation of the armature core has been favourable. Another practical advantage of importance is the diminishing of the weight of the armature, and consequently increasing the durability of the bearings, and making the armature much more easily handled in the case of repairs and renewals. Undoubtedly great improvements have been made in using machines with cut steel gears, enclosed from the dust, and running in oil. There has been, however, a tendency on the part of some manufacturers to cheapen the motor, by using too great a reduction in the gears. Considering the gears by themselves, the reduction should not be more than four and a half to one.

The matter of control seems to be pretty generally agreed upon. In municipal working, where the cars have to be started and stopped at frequent intervals, the series parallel control possesses great advantages. It becomes unimportant, however, when the stops are infrequent, and cars run over long distances. It might be inferred from the paper that the maximum traction effort was dependent upon the method of control, that is, whether it was a series parallel, or an ordinary rheostatic control. This, however, is not the case. The maximum effort that may be given by a motor is limited to its safe current carrying capacity. If two motors were started in parallel with the same starting effort, double the current would be taken, but the current through each motor would be the same as though they were operated in series.

Undoubtedly the suggestion of a ton mile is in the right direction, but there seems to be no finality in discussing the unit of motive power. Some companies prefer double bogie trucks, others prefer the use of extra long wheel bases, regardless of the curvature, while others properly advise limiting the wheel base according to the radii of the curves. Practical engineers seem to have been slow in finding out that an abnormal long wheel base is uneconomical in the consumption of current on the curves, and in the wearing of the rails and flanges of the wheels.

We are at a loss to understand why a trolley should be more liable to leave the line at section insulators than at any other part. A properly constructed section insulator should present exactly the same form of surface to the trolley wheel as to any other part of the line.

There remains much to say on the subject of guard wires. Preferably the guard wires should be placed alongside the telephone wires. Two guard wires properly placed with cross wires every 10 or 15 feet would catch any telephone wires before they had fallen any great distance. The placing of the guard wires above the trolley wire is objectionable in appearance, more or less ineffective, and has the disadvantage of being at some distance from the telephone and telegraph wires, so that when a wire falls upon the guard wire it has acquired sufficient energy, under the best circumstances, to make it a source of danger.

The rule given for bonding by Mr. Quin seems rather a radical one, in that it is specified that there should be $2\frac{1}{2}$ inches of contact area in the head of the bond, regardless of the current which it has to carry. Having in view that the web of an ordinary rail is not more than $\frac{1}{2}$ inch thick, this rule would be equivalent to saying that under all conditions the head of a bond should be something over $1\frac{1}{2}$ inches in diameter. We doubt whether many engineers would be willing to put such a regulation into force. A more satisfactory way of dealing with the problem would be to specify the maximum current density, since this determines the drop in the contact, and the liability of deterioration.

It is stated that 20 per cent. should be allowed for loosening of the joints. Such a recommendation does not seem to be consistent, since if the bonds loosen at all there seems to come between the joint and the rail a film of oxide, so that the contact is completely destroyed. Considering, however, that the body of the bond is of much less conductivity than the rail, the drop in the rail should be calculated, and allowance should be made for the drop in the bonds themselves.

The discussion on conduits is somewhat limited. From the municipal point of view, where there is no "21 years' purchase" clause to be considered, it seems possible that conduits may find favour in England in the future, especially in those cities where gas and water pipes will not be generally interfered with. The advantages of the double insulated conduit system are, that the trouble of dealing with the Board of Trade as to volts drop in the earth return disappears, and there is gained the great advantage of an entirely insulated return circuit.

While there is a great difference in figures as to the cost of maintenance and depreciation of accumulators, and the extra cost of running an accumulator system over that of the overhead trolley system, there can be little doubt that such extra cost exists in most cases to a practically prohibitive extent. The difficulties to be overcome in accumulators are first, to lessen the cost of maintenance; second, to lessen the first cost; and third, to lessen the weight, since the excessive weight of an accumulator car is objectionable, either the track or the rolling stock considered.

Various methods of charge and discharge have their advocates, according to the type and weight of battery, but the ultimate commercial result seems to be about the same in all cases. While figures more or less satisfactory have been coming from the Continent, we have to bear in mind the most prominent case in England, one in which

various companies in turn came forward, believing that they could show the required result; each in turn failed to make a commercial demonstration, and advanced the opinion that they could obtain the desired result had the conditions been different, and while we have no particular faith in accumulator traction at the present stage of development of the electrical accumulator, we would be interested to see under what conditions of electric traction each accumulator company would consider that it might make a commercial success of electrical traction with its own type of battery. In the case of overhead lines it frequently takes some two or three years to so perfect a system of operating that the works' cost may be reliably made out and reduced to a minimum. The figures, then, as to accumulator traction on the most favourable basis would be misleading unless extending over a period of years, since the cost of maintenance of an accumulator is far more uncertain than any feature connected with the trolley or conduit system of electric traction.

The conclusion reached by Mr. Quin seems to be the only one warrantable, and the only one that will be reached for some time to come.

PROPOSED STANDARD DIAGRAMS OF ELECTRICAL APPARATUS.

By Prof. ANDREW JAMIESON.

You were kind enough to send me a copy of the *Western Electrician* and of *Electricity*, both of America, containing reports of a committee of the Chicago Electrical Association for February, 1898, wherein it was stated—

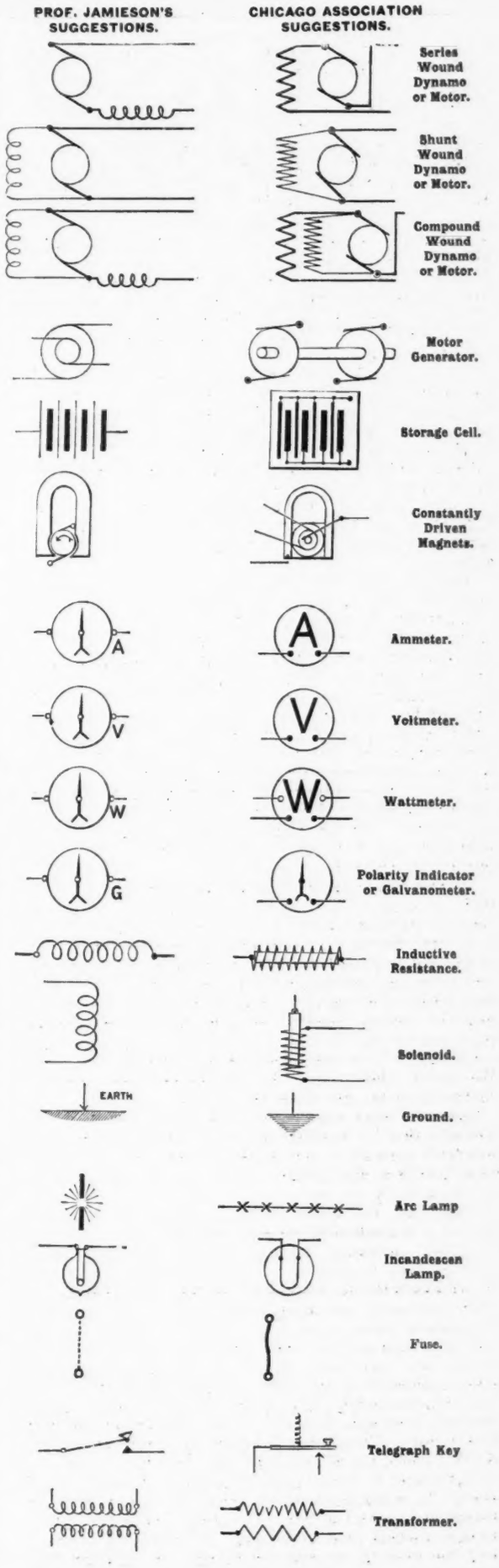
"The time has arrived when the diagrammatic illustration of electrical apparatus should be reduced to an art. A uniform code should be established containing a diagram for each piece of apparatus, each diagram being at once simple and, so far as possible, suggestive of the particular piece of apparatus which it is designed to represent."

"A decided improvement has been made in this direction during the last few years, yet at the present time the system is far from perfect. Its development has suffered through a lack of unity among the various makers of these diagrams."

"The electrical divisions in the Patent Office have done more toward the development of this art than any other one agency. Often in a drawing accompanying an application for a patent, when a circle was used to represent a battery, and another circle exactly like it to represent a dynamo, and still another, differing in no respect, representing the ground, the drawing was necessarily confusing, and was followed with difficulty, if at all. In such cases it has not been infrequent for the Patent Office to suggest to the inventor or his attorney that he submit a new drawing, using a certain adopted form or diagram to represent his battery and another to represent his dynamo, and so on. In this way, and with the well-directed efforts of a number of patent attorneys, a great improvement has been made. These diagrams are to further assist in this direction."

Then follows some 55 diagrams of electrical apparatus with an explanation thereof. I have looked over these diagrams, and have read the remarks as published in the American papers, and herewith offer some suggestions for improvement in the proposed figures. I do so from having taken a special interest in this matter for a number of years, and from the fact that I read a paper in May, 1885, before the British Society of Telegraph Engineers on "Electrical Definitions, Nomenclature, and Notation," and when we had the benefit of M. Hospitalier's discussion thereon.*

Since then I have frequently advocated an International uniform system of definitions, symbols, and electrical diagrams, and have from year to year published in "Munro and Jamieson's Pocket Book," a few of the simpler figures.



* For M. Hospitalier's views, see "Communication faite à la Société Internationale des Electriciens, le Novembre, 1884," and for my paper see *Journal of Society of Telegraph Engineers*, p. 297, 1885, Vol. xv.

Consequently I have much pleasure in complimenting the energy and ability shown by the Chicago Electrical Association in going one step further than any other similar association has hitherto done. I have, therefore, taken the liberty of cutting out a few of their figures and pasting alongside thereof what appears to me to be improvements thereon.

In the first place, their figures for series, shunt, and compound wound dynamos or motors, have the objections of representing the field coils by zig-zag lines which have hitherto been universally adopted to represent non-inductive resistances, whereas the field coils of such dynamos are anything but non-inductive. Further, in the case of the series and compound wound dynamos or motors, their diagrams are unnecessarily complicated by drawing the leads from each brush with two right angles, whereas in the diagrams usually adopted by electricians, and shown in my figures to the left, the leads come straight away from the brushes.

Their figure for a motor generator is greatly simplified, and conveys the full meaning desired to be imparted by that which I have shown on the left.

With regard to the storage cell, I think all that is necessary to distinguish it from a primary battery are the letters S and B respectively, placed underneath the usually accepted sign of long thin and short thick parallel lines.

Granted that there are cases where it might be necessary to distinguish between the hand generators at subscriber's stations and the power generators at a central office, I don't see the slightest necessity of complicating the figure of a constantly driven magneto by inserting lines to represent the belt when a mere arrow on the armature spindle would be sufficient, as shown by my figure to the left of theirs.

With regard to ammeters, voltmeters, wattmeters, and polarity indicators, or galvanometers, I think you will agree with me that those shown on the left are much simpler, neater, and sufficiently distinguished from each other by the letters A, V, W and G.

In the representations of an inductive resistance and a solenoid, it will be noticed that the iron core is omitted in my suggestion as shown on the left. Surely, the fact of a wire being coiled in a spiral form is sufficient to convey the idea of the presence of a certain amount of self-induction ?

With respect to the next diagram, we do not in this country speak or write of a connection to the "*ground*," but to the *Earth*, and what could be more in harmony with the well-known and long-accepted telegraph symbol as shown on the left ?

There can be no objection to a number of crosses, as shown, to represent arc lamps in series, but for the indication of a single lamp I should recommend the diagram on the left.

My next three diagrams, as representing an incandescent lamp, a fuse, and a telegraph key, are also more in conformity with practice than the corresponding ones indicated by the Chicago Congress.

Finally, we have again to find fault with their use of the well-known symbol for non-inductive resistances in the representation of a transformer.

Other objections might have been found, but these are sufficient to show a diversity between American, British, and Continental practice, and hence the need for coming to an early state of uniformity.

STANDARD METHODS OF ENGINE TESTING.

More than ourselves, Americans have aimed at standardising everything, and they have fairly well agreed on a standard method of testing boilers and also pumping plants, but, so far, without including power engines, excepting locomotives. Mr. Geo. H. Barrus, a well-known expert, pleads for a standard method of engine testing in a paper to the American Society of Mechanical Engineers. It is desirable that something of this sort should be arranged with a view to bringing experimenters into line and expressing results on a system whereby one test can at once be compared with others, so far as comparison is possible. Such a system involves, of course, an adherence of the engine builders who should turn out no engines unless suitably provided with testing facilities.

The present writer was recently testing a plant by a first-class firm which was provided with means for taking the temperature of the boilers. The means of doing this had not been placed there by the makers but by the owners, and consisted of iron tubes screwed into the manhole cover and filled with mercury. The tubes did not, however, extend into the boiler as they should have done for at least 6 inches, in order to secure that the mercury should be practically as hot as the steam in the boiler. Between the steam gauge and the thermometer reading there was a very serious discrepancy which completely vitiated the readings, and they were discontinued. The fault was pointed out to the owners at the time. If tests are to be standardised and a given system or method should thus come to be a kind of official recognition, it will behove testing engineers to be exceedingly careful in even such small matters. In the case in point the rendering of false figures might have satisfied the owner, in that he could not have known their inaccuracy.

Of course these remarks apply more particularly to the testing of special inventions generally. A man who agrees to pay for a report which he has been hoping will be a good report on which to sell a patent, is disappointed when he gets an unfavourable report, and sometimes will snatch at the veriest straws of an excuse in order to avoid payment, and it is by no means always easy to bring clearly out in a Court of Law that a test has been fairly conducted, company promoters seeming to think that engineers are made for the purpose of reporting within lines to be laid down by the promoters, and which cannot give fair results. Having so far protested against standard methods, we may fairly consider Mr. Barrus's proposals.

As regards efficiency tests, the requirements are the weight of steam consumed and the power developed, and these two elements are fundamental, whatever the type of engine, and whatever the class of work performed. Tabular results may thus come under the above two heads, the one dealing with such data as apply to the working of steam in the cylinder, and the other with the data pertaining to the special duty of the engine. Thus the first section would contain all data of feed measurement, the steam consumed in jackets and reheaters, the quality of the steam, the weight of steam used by auxiliaries, and all data as to pressures, temperatures, and speed, with further figures to be obtained from the indicator cards. It would also present the efficiency as per the standard method.

In the second section the figures and data would be recorded under one of five classes, according as the engine came under the head of factory driving, pumping, locomotives (*a*) in shop, (*b*) on the road, electricity generation, marine engines.

Under the first section a simple expression of efficiency could be employed, based on the amount of heat used per gross or net horse-power per unit of time. Such a section would present the results of a coal test if such were made, in the shape of weight of coal burned and all the results deduced therefrom. Under the head of pumping the duty could be expressed in foot-pounds of duty per million heat-units. Freed from the friction of long mains, the pumping engine is a simple machine to measure, or even then the use of pressure gauges will enable resistance to be measured. Indeed, it may be recorded continuously. Locomotives would be reported as per the consumption of coal per dynamometer pull, a standard coal being employed.

Electric engines would be reported on the basis of quantity and intensity of current generated, the electrical H.P. generated, and the generator efficiency, and, on railway work, the current delivered to the motors; this, to us, however, seeming to be somewhat external to the steam engines, as also does the item, in marine engine tests, of tonnage moved a given distance per power unit, a matter depending rather upon the build and fineness of the ship than on any quality of its engines.

As to obtaining the results, one of the most important is the work performed by the steam. Mr. Barrus rightly lays stress on the importance of the indicator, and in a system of standardising, he would have the calibration of springs,

the operation of the instrument, the method of diagram measurement, all determined and placed on a uniform basis. Much depends on the placing of an indicator; there are no accepted methods of calibrating springs, and so on, to which we might add that of equal importance are brake strap details, the comparison of the brake and the indicator being essential to a determination of engine mechanism efficiency. Mr. Barrus desires to set the ball rolling, and suggests a committee of investigation to place the subject on a firm basis.

REVIEWS.

Automobiles sur Rails. By G. Dumont. Paris: Gautier-Villars et Fils.

This is a little book on tramway motors or automatic vehicles. It is a brief description of the various kinds of mechanical tramway motors. The importance of tramway traction is apparent when it is known that in Paris the annual journeys per inhabitant were 50 in 1856 and had mounted to 155 in 1891. One of the earliest motors was that constructed in 1838 or 1840 by Andraud and Tessié. It was furnished with a compressed air engine and carried eight persons. This worked successfully at Chaillot, but never came to a practical success.

In 1848 a steam motor carrying 60 passengers ran at Bristol. In 1859 the first steam trams were run in the United States. After that progress became more marked. At the present time there are seven types of tramway motor, viz, steam, compressed air, gas engines, carbonic acid, ammonia motors, cables and electricity.

The different systems are described, and a distinction is drawn between systems self-contained and systems in which power is transmitted from a centre. In the Rowan system of steam car the four-wheeled truck which carries the engine and boiler is placed under one end of a car of which the other end is carried by a single pair of wheels, the combination taking curves easily.

The motor truck can readily be detached from the rest of the vehicle and replaced by a similar truck, a convenience for repairs, &c. Various other steam systems are described, including that of Lamm et Francq, which has no furnace, but works from a store of highly heated water. The Mekarski and other air systems are briefly noted, also the Lührig system of gas power, of which we seem to hear so very little from its installation at Blackpool.

Carbonic acid motors are worked by carbonic acid compressed to 75 atmospheres. It is worked in cylinders of 0·10 in. diameter × 0·15 stroke (say 4 inches × 6 inches) with Corliss valves, and reheating by a gas flame is effected near the point of admission. The consumption of gas is given as 4½ kilos. per H.P. day of 24 hours, or 190 grms. per H.P. hour. Liquified gas costs 0·37 fr. per kilo. The cost is 0·07 fr. per H.P. hour.

Ammonia motors, first proposed in 1821 by Gurney, are worked by compressed anhydrous ammonia, which liquifies at about—34° C., or at 27° C., if under ten or a dozen atmospheres. The exhaust ammonia is taken up by water which absorbs 1,700 times its volume of ammonia, and the combination develops heat which is employed to heat the compressed ammonia. In 1896, there was put in service, on 22nd Street, New York, motors of 50 H.P. with 75 atmospheres pressure. The consumption of ammonia was 13·6 lbs. with single, and 27·2 lbs. with double gear, the expense being 0·03 fr. per car kilometre plus 0·044 fr. for fuel at the compressing station.

In the electric section various conduits are illustrated in a diagrammatic manner. We observe that the illustration of the Holroyd Smith conduit is placed upside down. Generally the illustrations are too small. A bibliography is appended. Largely historical, the book is by no means a full technical hand-book of tramway motors, but is useful in gathering between two covers a good deal of information as to what has been effected in the way of mechanical traction by other means than electricity as well as by the latter agent.

Radiography and the X Rays, in Practice and Theory, with Constructional and Manipulatory Details. By S. R. Bottone. Whittaker & Co., London. Price 3s.

Mr. Bottone's little volume will be of great use to amateurs and others commencing the practice of work with the Röntgen rays. Mr. Bottone himself has evidently done a good deal of work in this field, and has designed and constructed a good deal of the apparatus. Those who are not in a position to purchase induction coils and influence machines from the makers will here find instructions sufficient to enable them to make very decent instruments for themselves. Mr. Bottone is evidently an enthusiastic believer in the influence machine, and especially in the Wimshurst machine, as a source of current for exciting the Röntgen tube. In this respect we think his enthusiasm carries him too far. Unless influence machines of a very large size are used, the time of the exposure necessary to produce a good photograph is inconveniently long. For screen work the influence machine is superior, on account of the greater uniformity of its discharge. Moreover, Mr. Bottone would lead us to believe that the Wimshurst machine is superior to the Holtz for X ray work; but if he makes comparative exposures with a Wimshurst and Holtz of equally good construction, he will, we reckon, soon convince himself of his error.

When Mr. Bottone drops into theory we do not find him quite so reliable a guide as in the manipulatory department of his subject. He tells us (p. 17) that the undulations inside the Crookes tube have the property of attracting light bodies—a statement which would be distinctly misleading to the beginner, seeing that it is now well known that these effects are due to electric charges which accumulate on the walls of the tube. He also repeats an assertion, which though made some time ago by a great authority, has since been completely disproved, viz., that the electric conductivity of bodies such as ebonite and paraffin is increased by the action of the Röntgen rays. A serious blunder, which no doubt is due to an oversight, is made at p. 165, where it is asserted that by introducing self-induction coils into a circuit we shorten electric waves and quicken the oscillation: the very opposite is the case.

CORRESPONDENCE.

Visual Telegraphy; or, Seeing by Wire.

With reference to the correspondence on the above question, which has been prominently brought forward by the recent announcement of Herr Szczepanik's (of Vienna) invention, may I be allowed to say just a few words.

As to Herr Szczepanik's invention, I, like many others, doubt if it could be brought into successful application, as the speed at which the revolving mirrors would have to work would be impracticable, at least, without serious breakdowns; and besides, the apparatus as a whole looks very cumbersome in spite of its novelty. As to the practicability of "Visual Telegraphy; or, Seeing by Wire," I have strong hopes of its possibility of solution, but the difficulties in connection with it are chiefly mechanical. Selenium cells and revolving mirrors will have to be superseded by something more sensitive and constant in action. I have some ideas how I think it could be accomplished with, and which I drew up some time ago, and which I expect to be able to put into practical effect ere this time 12 months, and which, as I anticipate, if successful, would bring distant views into drawing rooms, offices, and palaces of varieties, &c. The receiver will be able to see the transmitter; the ladies in the parlour would be able to hear and see the acts and plays in the theatre, &c., without moving out of their doors; and subscribers will be able to ring themselves up in connection with any place of amusement. Notable scenes such as the late Mr. Gladstone's funeral or the Queen's Jubilee procession, will be able to be rung up into the large halls in the provincial towns for reproduction on large screens. As to what the fundamental principles of my ideas are, it would not be wise on my part to disclose them at present, as some wise individual may try to forestal me, but I am quite confident of success in the

near future. There is one fact in connection with this subject, and that is, we know very little as yet of the actions and ways of light waves when conducted electrically. Some say that visual telegraphy is impossible, and some say it may be possible, but time and experiment alone will tell.

Thanking you for your kind insertion of this letter,

Geo. Smith.

June 20th.

ELECTRIC LIGHTING AND REFUSE DESTRUCTION IN BERMONDSEY.

Another Sanguine Report.

The Bermondsey Vestry on Monday evening considered a very lengthy report from Messrs. Kincaid, Waller & Manville, on the advisability of erecting a refuse destructor in conjunction with the projected electric light station. As the subject is of considerable interest at the moment, we make no apology for giving the following abstract of the report in question:—

Report of Consulting Engineers.

Referring to our report of June 26th, 1897, in which we pointed out that having consideration of the fact that at the time this report was made the cost of disposing of your house refuse was only about 1s. 2d. per ton, whilst the cost of burning it in a destructor would be more than 1s. 10d. per ton, and that under those circumstances we did not imagine that you would care to have your system of disposal of the ash-bin refuse changed, we have, in accordance with your instructions given us through Mr. Ryall, your vestry clerk, reconsidered the matter, after having consulted thereon with Mr. Sumner, the surveyor to the Vestry.

From the information that gentleman has been good enough to give us, it now appears that the cost of disposing of the ash-bin refuse is as much as 1s. 8d. per ton, and in your case, as in the case of all other London vestries, this cost of disposal of your ash-bin refuse by carting away or barging away, is likely to increase rather than to diminish.

It also appears that if a site in the vicinity of the Vestry Hall could be secured for the erection of a combined dust destructor and electric generating station, the heat produced by the combustion of the ash-bin refuse might be economically utilised for heating the baths' water, &c., and working the machinery used in the baths and washhouses, with a consequent additional saving that would be effected by the utilisation of this heat for the production of electrical power also.

We have reconsidered the matter on these new bases, and beg to append estimates, which, we trust, will put the financial position produced before you clearly.

The estimates submitted show (1) that the capital cost of additional works incidental to a six-cell destructor, to deal with 11,711 tons of refuse per annum, would amount to £10,000; (2) that the annual maintenance would be 2s. 4d. per ton of refuse, or a total of £1,359; and (3) the saving and revenue to £1,170 per annum, leaving a deficiency of £189. Against this would be set the present cost of £975 incurred in disposing of 11,711 tons of house and trade refuse at 1s. 8d. per ton, leaving an estimated net saving of £786 per annum.

After detailing the manner in which the above figures have been arrived at, the report proceeds:—

In the estimate of annual maintenance, we have taken the labour and superintendence on the basis of the destructor only being run six days in the week in place of seven, enabling you to work two shifts a day only. We have taken the cost of the removal of the clinker at 1s. 10d. per ton of clinker removed. (In this figure we do not quite agree with Mr. Sumner, who has estimated the cost of this, including both carting and tipping, at 2s. 8d. per ton). From our actual experience at Shoreditch, however, where the cost of removing clinker must be at least as great as in any other part of London, and where only 1s. 10d. per ton is paid for this service, we have no hesitation in expressing an opinion that you will be able to dispose of such of your clinker as you require to have removed for no greater charge than this. The amount of clinker is arrived at on the assumption that only 25 per cent. of the refuse burnt will be produced as clinker. At Shoreditch the percentage of clinker is about 30 per cent., but there can be little doubt that the refuse at Bermondsey is richer in combustible material than at Shoreditch, and we have therefore taken 25 per cent. as the residue. Of this 25 per cent., it is estimated by Mr. Sumner that one-third can be utilised for the purposes of the parish.

We, therefore, believe that this inclusive estimate of maintenance for the burning of refuse, amounting to about 2s. 4d. per ton, is one that can be worked to in practice.

The saving and revenue per annum takes the credit for the steam which may be utilised for the baths heating purposes, and also supplying power there, which at present consumes coal to the value of £431 19s. per annum. We have allowed in this estimate, as a debit to this item, the interest and sinking fund on £1,000, which sum it might be wise to spend in providing apparatus to enable the baths to be heated by the utilisation of the exhaust steam from the electric light engines, in place of using live steam from the boilers for this purpose; for you must bear in mind, that for all heating purposes, where the water is not required to be raised above boiling temperature, exhaust steam is practically as useful as live steam, leaving only live steam to be used for the actual boiling in the washing troughs. Credit is taken for one-third of the clinker produced at 2s. per ton. This price, Mr. Sumner estimates it will be worth for other parish purposes. There is a credit for 2,180 tons of combustible trade refuse which we have taken at 2s. 6d. per ton, but which is included in Mr. Sumner's figures at only 1s. 8d. per ton. Here, again, we feel sure, from our experience at Shoreditch, that at least 2s. 6d. per ton can be obtained for the burning of trade refuse on the average.

Then comes the estimate of coal saved in the electric generating station, which is calculated on the basis of the destructor running only 6 days per week, coal being used on Sunday. We have no hesitation in stating definitely that the 11,000 tons of refuse you have to burn will produce all the power required for the plant you are proposing to put down in the first instance in your station, as the proportional amount of power produced at Shoreditch per ton of refuse is greater than this, notwithstanding that probably their refuse has a smaller calorific value than that at Bermondsey.

Finally, you must bear in mind that during a great portion of the day the live steam produced by the dust destructor will not be utilised, as the electric generating station will then be producing but a small output, unless a day load is found in the shape of a supply of current for motive power purposes.

The financial statement shows you that under these estimates a net saving of £786 15s. 4d. per annum will probably be made on the combination of a dust destructor with the electric generating station and baths, which is so considerable an amount as to cover all contingencies and still leave a certainty of a considerable annual saving being made, whilst, on the other hand, you will be sure that the price of disposing of the refuse will remain a constant quantity year by year.

Mr. Cox, chairman of the Electric Lighting Committee, formally recommended that, in the event of the Bill being passed confirming the Vestry's provisional order, the report of Messrs. Kincaid, Waller and Manville should be adopted, and a refuse destructor erected with the electric lighting station. After some discussion the recommendation was unanimously agreed to.

LONDON COUNTY COUNCIL.

At the weekly meeting on Tuesday, the Council approved a loan of £2,950 to the Vestry of Islington for the purpose of acquiring the fee simple and subsidiary interest in six houses in order to enlarge the electric light station in Eden Grove.

Forthcoming Boiler Contract.

It was resolved, on the recommendation of the Main Drainage Committee, to invite tenders for the supply of four high-pressure Lancashire boilers to work at 150 lbs. pressure for the Western pumping station.

Lighting of Theatres.

The Theatres Committee reported that the requirements of the Council in regard to electric lighting arrangements have been carried out at the following places:—Adelphi Theatre, Strand; London Music Hall, 95 to 99, Shoreditch High Street; Royal Cambridge Music Hall, 136, Commercial Street, Whitechapel; Salle Erard, 18, Great Marlborough Street; and Standard Theatre, Shoreditch High Street.

New Central Station.

The Building Act Committee announced that they had conditionally approved the plans submitted with the application of Messrs. Kincaid, Waller and Manville on behalf of the South London Electric Supply Corporation, for the construction of a generating station and works on a site adjoining Bengeworth Road, Loughborough Junction, and authorised the erection of the generating station and works as shown upon the plans.

Electric Lighting Provisional Orders.

The Highways Committee, reporting upon the provisional orders considered during the 1898 session, said:—Of the 11 provisional orders applied for this session, the Board of Trade has granted only four, namely, those applied for by the Vestries of Bermondsey and St. Marylebone in respect of their respective parishes, and an order each to the Charing Cross and Strand Electricity Supply Corporation and the County of London and Brush Provincial Electric Lighting Company in respect of portions of the Holborn and St. Giles districts. The Board has adopted many of the amendments suggested on behalf of the Council; but as we have reported to the Council, has declined to insert the suggested clause for the protection of the Council's tramways. The limit of price in the companies' orders has been reduced to 7d. per unit, but in that of the Vestries the price is as in previous orders, 8d.; in the companies' orders the provision as to continuous current has been omitted, but it has been inserted in the Vestry orders, from which, moreover, the clause enabling the undertaking to be transferred to a company has been struck out. Two or three of the suggested amendments, which have not been adopted by the Board, we consider of some importance; and we are endeavouring to induce the Board to insert them, but the Council has obtained substantially the principal amendments for which it asked.

In a further report the Committee stated that the Board of Trade has intimated that with regard to the power of purchase by local

authorities, it has not been the practice of the Board to vary the term of the years prescribed by Section 2 of the Electric Lighting Act, 1888, except in special cases, at the request of the local authorities and with the concurrence of the promoters, and that, as in the case of these orders, no request has been made by the local authorities concerned for a variation of the term, the Board is unable to concur with the suggestion that the term should be seven years; and that the Board proposes to take the necessary steps to secure the insertion in the No. 2 Order of the other amendments suggested by the Council.

Electric Supply in Bulk.

Reporting on the recent conference with London local authorities on the telephone service and generating stations for the supply of electrical energy in various districts, the Highways Committee referred as follows to the latter question:—

"The object of the Central Electric Supply Company's Bill, deposited this session, is to enable the company to supply electrical energy in bulk to local authorities and companies authorised to supply in the areas defined in their respective orders under the Electric Lighting Acts, and for this purpose to acquire lands compulsorily and to erect and maintain generating stations thereon. Power is also sought to break up streets for the purpose of laying what may be termed trunk mains from the generating stations to the point at which the energy is to be distributed by the receiving local authority or company. Thus the streets under the jurisdiction of one or more local authorities may have to be disturbed in order to afford the supply in bulk to a local authority or company at some distance from the source of supply. This is shown clearly by clause 8 of the Bill which proposes that the company shall have power to break up streets and to lay electric lines and place boxes and apparatus for all purposes of electrical supply, and 'do all other acts which they (the company) may deem necessary for supplying electrical energy to any company, body, or person, authorised to generate or supply, or generating or supplying, such energy for any public or private purpose within the County of London, and may supply such energy accordingly.'"

"The Chelsea Electricity Supply Company's Bill is to empower the company to take lands in the parish for the erection of generating stations, for use in connection with the supply of electrical energy in the area under the company's order; and the Metropolitan Electric Supply Company's Bill has two main objects, viz.—(*a*) to authorise the company to hold certain lands, recently acquired by the company, at Acton and Willesden for the erection of generating stations to supply districts included in the area of supply under the orders granted to the company; and (*b*) to authorise the company to lay down cables and other necessary apparatus from the generating station to the company's station at Amberley Road, in the parish of Paddington. The Bill provides, however (clause 9), that the consent of any local authority, through whose district it may be necessary to lay mains, shall be obtained before the mains are laid. The effect of the clause, as drawn, would appear to be to repeal the provisions of the company's orders which forbid supply beyond the areas defined therein.

"The proposals in these several Bills form a new departure; the policy hitherto pursued having been, in view of the ultimate purchase by the local authority of each undertaking authorised by an order granted to a company, to provide that the whole of the undertaking, including the generating station, should be within the area of supply."

The Committee then proceeded to refer to the appointment of the Parliamentary Committee and to its conclusions, and mentioned that they proposed to report to the Council again on the subject, in the meantime giving the text of the resolutions passed at the Conference of local authorities held last week.

BUSINESS NOTICES, &c.

Announcement.—Messrs. A. & W. Hopkins state that they have taken Mr. Montague H. Galsworthy in as partner in their fittings manufactory carried on at 7, Hill's place, Oxford Circus, W., and that the business will in future be carried on under the name of "The London Electrical Fittings Co.," and under the same management as at present. The accessories supply business will be carried on as heretofore, under the name of A. & W. Hopkins, at 30, Parliament Street, Westminster, S.W.

Annual Outing.—The Aberdeen Electricity Works' staff went for their annual outing to Benachie.

Arc Lighting.—Mr. G. Braulik, of Upper Thames Street, E.C., informs us that Messrs. Korting & Mathiesen now manufacture a continuous current arc lamp which burns three in series on 110 volts with resistance.

The Ariel Arc Lamp Syndicate, Limited.—In the Chancery Division of the High Court of Justice on Wednesday, June 22nd, Mr. Justice Byrne made a compulsory order winding up this company, on the petition of Mr. J. Jones and others.

Books Received.—"A Text-Book of Zoology," by H. G. Wells and A. M. Davies. Published by W. B. Clive, University Correspondence College Press, London. 6s. 6d.

"Electrical Testing for Telegraph Engineers." By J. Elton Young, M.I.E.E. *Electrician* Printing and Publishing Company, Limited, London. 10s. 6d.

The General Power Distributing Company's Bill.—A Select Committee of the House of Lords, presided over by the Earl of Northbrook, on Tuesday entered upon the consideration of the scheme of the General Power Distributing Company Bill, the object of which is to enable the company to supply electricity for lighting, traction, and other purposes to a district embracing an area of 2,000 square miles, including the towns of Sheffield, Rotherham, Lincoln, Gainsborough, Newark, Nottingham, Ilkeston, and Worksop. The central generating station is to be at Worksop, in the midst of a colliery district, and the promoters state that by the use of coal slack for generating purposes, which they will be able to procure at 2s. per ton, they will be able to produce electrical energy at an extremely cheap rate. In view of the large average demand which they hope to develop in the area of supply, they expect to be able to sell electricity at 1d. or 1½d. per unit, whereas the present charge in Notts, where the electric lighting undertaking is in the hands of the Corporation, is 4d., having been reduced from 6d. to 4d. since the Bill was introduced. The measure is opposed by a large number of local authorities, including the Town Councils of Sheffield and Nottingham, but it is supported by a numerous body of traders in the district. Over 70 petitions have been presented in its favour. The case was opened, says the *Times*, by Mr. Pember, Q.C., for the promoters, and among the witnesses called in support of the Bill were Mr. Bainbridge, M.P., Mr. Lupton, C.E., and a representative of the Nottingham Chamber of Commerce.

The Committee on Wednesday heard further evidence in support of the proposal. The Duke of Newcastle said that if the scheme were carried out he would employ electricity for the lighting of Clumber and for other purposes. The Duke admitted that the Corporation of Nottingham had lately put down mains to supply his estate in the city of Nottingham with electricity under an agreement, but he would prefer to have two strings to his bow, so that his tenants might have the advantage of a cheap supply. Mr. Thomas Bayley, M.P., also gave evidence in support of the scheme, which would benefit the mining and agricultural interests in the Chesterfield Division of Derbyshire.

Changes of Address.—The Wheeler Condenser and Engineering Company have found it necessary to extend their office accommodation, and have taken new premises at 171, Queen Victoria Street, E.C.

The Blake & Knowles Steam Pump Works, Limited, have found it necessary to remove from 117, Queen Victoria Street, to larger premises at 179, Queen Victoria Street.

Conduit Wiring.—The Simplex Steel Conduit Company, Limited, of Birmingham, who, as stated in our issue for May 27th, have published lists describing their "ideal" method of wiring for lighting and other electrical work, have sent us some samples of tubing, T junction bends, and elbows used in their system, which, upon examination, appear to be well made of light enamelled steel tubing. It is claimed that the Simplex conduit affords complete mechanical protection, and preserves the insulating property of the dielectric in a highly efficient state, enabling the circuits to be drawn in and out of the conduits with ease and freedom, and without possibility of abrasion. The process of enamelling renders the tubes and fittings very durable, impervious to rust and consequent depreciation, and is claimed to give them a perfectly smooth exterior and interior insulating coating. The accessories have been designed to meet the requirements of concealed and surface work. It is claimed that a wireman of average intelligence would find no difficulty in erection, as no screwed couplings are used, and consequently, no special tools are required. Mr. L. M. Waterhouse, A.I.E.E., is the company's engineer and manager.

Dividend.—Messrs. Schuckert & Co., of Nurembourg, is declaring a dividend of 14 per cent. for the past financial year.

Electric Cabs.—We understand that a contract has been given to the Gloucester Railway Carriage and Waggon Company, Limited, by the London Electrical Cab Company, Limited, of Lambeth, for the building of a number of their cabs.

Electric Lighting in Chili.—Die Electricitäts Gesellschaft Santiago-Chili is the title of a company which has just been formed in Berlin, with a capital of £1,200,000. The Allgemeine Electricitäts Gesellschaft and Messrs. Ludwig Löwe & Co. are interested in the new undertaking.

Electrical Progress in Milan.—Our Consul, in his annual report, remarks that although electric traction has not yet been applied to all the tramway lines in Milan, the first year's working under the new arrangement has resulted in a net profit for the municipality of £38,000, as compared with about £14,000 under the old system, and it seems probable that the current year will give even more satisfactory results. In the course of the next few months the Edison Company, which works the electric tramways on account of the municipality, will bring into Milan a force of nearly 10,000 H.P., obtained from the River Adda, at Paderno. Six turbines, each of 2,160 H.P., with a seventh as a reserve in case of accidents, will be employed for developing the water-power, and conveying it to the dynamos, which will be seven in number, and the electric current will be carried from Paderno to Milan, a distance of 20 miles across country, by means of overhead wires. These turbines are said to be the most powerful hitherto in use in Europe, and are being constructed by the local firm of Riva, Monneret & Co. It is estimated that the loss of power in transit will not exceed 9 per cent. Of the nearly 13,000 H.P. to be thus developed, 2,000 are already disposed of in the town of Monza. The remainder will be brought to Milan, and any surplus that may remain after providing for the public and private lighting of the city, and the working of the tramways, will

be let for industrial purposes. In 1897 the Edison Company increased its capital from £360,000 to £540,000. It has just declared a dividend for last year of 6 per cent. The use of electricity, both for lighting and motive power purposes, is constantly extending, and there is consequently an ever-increasing demand for all kinds of electrical appliances. Some of these are now made in Italy, but by far the greater part come from Switzerland and Germany, two countries which appear to have made this industry, which has undoubtedly a splendid future before it, quite a speciality of their own, and they must find it a very profitable one. *British engineering firms, it is stated, do not seem to be making any effort to secure a share of this business in Italy.*

Exhibition.—At the Royal Agricultural show, which closes to-day at Birmingham, Messrs. John Fowler & Co. (Leeds), Limited, have been exhibiting a variety of agricultural traction engines, road locomotives, and other light railway plant, &c.

Messrs. Ruston, Proctor & Co., Limited, of Lincoln, are also exhibiting at Birmingham a number of prize steam engines and machines, including the Ruston oil engine.

Fire.—A fire of a very destructive character broke out at a quarter past one o'clock on Thursday morning last week, causing the destruction of 19 and 21, Heddon Street, Regent Street, W., the premises of Messrs. Davies, Kent & Stewart, manufacturers of electric light supplies, flexible wire, &c. From the first the fire spread rapidly, and Commander Wells, R.N., assisted by Supt. T. Smith, ordered a large force to the scene, and set 19 steamers to work. The firemen had to complain of short supply of water in the early minutes of the fire. A huge telephone derrick on the top of the burning building suddenly collapsed, and the mass of metal, weighing some 40 tons, crashed into the centre of the roadway, but, marvellously enough, no firemen were injured. As announced in another part of this issue, Messrs. Davies, Kent & Stewart have secured premises at 17, Berners Street, W., where all communications should be addressed.

Harvie & Co., Limited, v. Gavin.—In the Glasgow Court of Session on 17th inst., this appeal was heard and judgment given. It was an action raised in the Sheriff Court at Glasgow by Wm. Aloysius Gavin, proprietor of the *Register of Leading Marine Manufacturers*, 57, Gracechurch Street, London, against Wm. Harvie and Co., Limited, electric light engineers, and patent ship lamp manufacturers, 222, Broomielaw, Glasgow. The pursuer sued for £65 as fees due, at the rate of 12s. 6d. per week for 104 weeks, for the insertion of the defender's name in the *Register*. The defenders said that their name was not inserted in the *Register* upon their order; that a representative of the pursuers called upon them, and they agreed to the insertion being made provided no other firm appeared under the head of "Ship Lamps," and that the insertion of the word "Scottish," if inserted in the order before the word "firm," was inserted in breach of the agreement. The pursuers, in reply, said that the addition to the condition was made by arrangement with Mr. Harvie, and was read over by Mr. Harvie's manager before he signed it. Sheriff Substitute Guthrie gave decree for £61, to which the sum sued for had been restricted, and found the pursuers entitled to expenses. Their Lordships of the Second Division affirmed the decision of the Sheriff Substitute, with additional expenses.

List.—The Phaeton Electrical Company, Limited, of Watling Street, E.C., have issued Section No. 1 list, in which they illustrate and give prices of ordinary incandescent lamps, 16 different types of usual caps being shown. A variety of special lamps, such as etched, silvered, coloured, tubular, battery, miniature, Phaeton sun ray and surgical lamps, also improved Phaeton lamps without plaster of Paris, are all included in the list.

Municipal Electrical Association.—On Friday, the 10th inst., a party of the members of the above Association visited the works of the Incandescent Electric Lamp Company, Limited, and were shown the whole of the operations in the manufacture of the "Robertson" lamp.

The National Company for the Distribution of Electricity by Secondary Generators.—On Wednesday last week, before Mr. Justice Wright, sitting in the Companies' Winding-Up Court, Mr. Rowden mentioned this matter, which is a creditor's petition for winding up the company. The case had been twice before adjourned on the ground that the matters in dispute between the creditor and the company were the subject of litigation before Mr. Justice Sterling. The Chancery action had been set down for trial, and it was hoped would shortly be disposed of, and counsel now applied that the petition should be again adjourned and not dealt with until after the proceedings in the Chancery Division. Mr. Gore Brown opposed the application, and asked that the petition should be dismissed. His Lordship declined to grant any further adjournment, and dismissed the petition.

New Premises.—Mr. R. Needham is about to open premises in Stanley Street, Southport, as an electrical and general engineer.

Overhead Wires.—Mr. G. Stegman, an electrician, of 45, St. John's Hill, has been summoned at the South-West London Police Court at the instance of the Battersea Vestry for placing overhead wires across St. John's Hill, without providing sufficient supports, and without giving notice to the Vestry. Mr. Young, solicitor to the Vestry, stated that, according to the bye-laws, the wire should be supported at every 100 yards. Eventually it was decided to adjourn the case, it being stated that the defendant had agreed to submit plans to the Vestry.

Reynolds & Branson, Limited.—Messrs. Reynolds and Branson, of Leeds, manufacturers of electrical apparatus, have formed themselves into a private limited liability company under the above style. The present partners take the whole of the shares, and retain the direction of the business as formerly.

Ship Lighting.—A complete installation of the electric light has been made on the steamer *Ula*, the latest addition to the fine fleet of the British India Steam Navigation Company's line. The masthead and side lights are also electric, and in connection with these, the builders of the ship, Messrs. William Denny & Bros., of Dumbarton, have fitted a new device called the "Voltometre," which is for the purpose of seeing if the lights are burning properly. In the chart room is a case with three small openings in it. Each opening is provided with differently coloured glasses, the centre being frosted, whilst those to the right and left have green and red glasses respectively, these corresponding to the masthead and starboard and port side lights in colour. When these lights are burning the openings in the case in the chart room are illuminated by incandescent electric lights. If by any means either or all of the lights become extinguished this is at once perceptible in the chart room, the voltometre corresponding with the lights on the mast and sides of the vessel. An alarm bell also rings, and continues to ring until the lights are set right again. Under ordinary conditions it is very difficult to see whether the lights are burning properly, and the new invention, which has been, or is about to be patented, will probably be a very valuable one. This is the first ship on which it has been used. The inventors are Messrs. W. Denny & Bros.

The Swiss Electrical Trust.—The *Financial News* Geneva correspondent says that the great Swiss Electrical Trust, projected for some time past, has now been called into life with a capital of £1,000,000, £600,000 of which has been taken over by the Banque de Paris et des Pays Bas, and the remainder by the Union Financière. It is probable that not only Switzerland, but France, will be included in the field of its operations.

Webster v. the Cox Thermo-Electric Company, Limited.—In this case, which came before Mr. Justice Romer on Saturday (June 18th) on a motion for judgment in default of defence in a debenture-holder's action, his Lordship made the usual order in a debenture-holder's action, and directed the usual inquiries. Counsel stated that the company was incorporated in April, 1896, that the debentures were a series of £500 charged on the undertaking of the company, that no interest had been paid, and that the charge became enforcible on failure to pay interest for one month.

Workmen's Compensation.—In connection with the Workmen's Compensation Act, 1897, which comes into force on July 1st, and also in regard to the Employers' Liability Act of 1880, Messrs. Wallach Bros., of 57, Gracechurch Street, E.C., send us lists of various safety appliances and fittings which have been introduced by them from time to time for the prevention of accidents in factories, &c. The lists describe the "Evertrusty" patent gauge glass protector, described in these columns some time ago, improved automatic belt-lifting apparatus, and the "Evertrusty" nose, throat, and lung protector and respirator, the last mentioned being of particular importance in all factories where workers are likely to come in contact with lead, noxious gases, &c. This article, we understand, has been tested for some time with satisfactory results.

ELECTRIC LIGHTING NOTES.

Accrington.—The Corporation, who already possess electric lighting powers for the borough, recently granted the trustees of the New Jerusalem Church permission to obtain electricity from the local Co-operative Society until such time as the Corporation are in a position to supply it themselves. The installation, which was put in by Mr. Simpson, electrical engineer, of Hapton, was used for the first time on Sunday last.

Alloa.—The Burgh Commissioners have resolved to do nothing meantime regarding the proposal to light the streets by electricity. Baillie Arrol intends moving that the Commissioners apply for a provisional order to protect themselves.

Bedford.—Last week a Local Government Board inquiry was held *re* the Council's proposed loan for £5,400 for electric lighting extensions. The Town Clerk explained the need for the extensions, and the general details were described by the electrical engineer, Mr. Hope-Johnstone. It seems that up to the present time £49,000 has been borrowed for electric lighting purposes. Sanction had been given to borrow £58,650, and, therefore, the Corporation had still power to borrow a further sum of £6,950. The present loan was for the extension of the engine room, with the necessary foundation, transformers, extra testing instruments, mains for public lighting, standards for lighting the market places, &c. This was necessary on account of increased demand, and for the public lighting of the St. Cuthbert's Glebe Estate. The total number of lamps at present was 14,250 8-C.P., exclusive of public lighting, and this scheme included 65 additional lamps for the St. Cuthbert's Estate.

Blackpool.—From a "Blue Book" just issued by the borough treasurer of Blackpool, it appears that the income from the electric lighting undertaking during the last financial year was £14,229, made up as follows:—Public lighting, £3,457; current for tramway traction, £1,286; private lighting, £9,010; rental of meters,

&c., £279; rents and sundry receipts, £197. During the same period the expenditure was £8,080, namely:—Generating current, £5,521; distribution, £468; public lighting, £928; rents, rates, and taxes, £255; salaries, management, expenses, &c., £908. The gross profit was £6,149, which, less loan charges £4,734, left a net profit of £1,415, against an estimated profit of £1,300. The balance was carried to the credit of the general district rate account. In 1896-7 there was a net profit of £828, and in the year before £281, whilst the two first years' working was at a loss. The units generated last year were 903,558, against 575,904 in the preceding 12 months, this being an increase of nearly 57 per cent. There are now about 50 miles of electric lighting mains, and the capital outlay last year amounted to £16,085.

Bournemouth.—The Town Clerk is to write to the Board of Trade on the subject of the proposed appointment of an electric inspector. The Council has decided to reconstruct the electric call-bell system at the three fire stations, and £225 is to be borrowed for the purpose.

Distillery Lighting.—The Mortlach Distillery, Dufftown, is to be lighted by electricity, water-power available in the neighbourhood being utilised. 150 lamps will be fitted up. Messrs. P. C. Middleton & Co., of Aberdeen, will carry out the works.

Cheltenham.—H.M. Inspectors of the Education Department having recommended that the class rooms and dormitories occupied by the students of the Cheltenham Training Colleges be lighted by electricity, the governing body of the Training Colleges has decided on wiring up the college for masters situated in Swinton Road, Cheltenham, during the summer holidays. The local borough electrical engineer (Mr. H. Kilgour) has drawn up specifications, and will supervise the work.

Chester.—The Council has authorised the Lighting Committee to have arc mains and distributing mains laid for the supply of public and private electric lighting in George Street, St. Anne Street, and adjoining streets at an estimated cost, including street lamps, &c., of £1,260.

Crossgates.—A recent meeting of the Hill of Beath inhabitants resolved in favour of public electric lighting.

Dublin.—A special meeting of the Corporation was held last Friday to consider the report of the committee of the whole house in reference to the tenders for the supply, laying down, and maintenance of electric mains and apparatus, in connection with the loan of £20,000. The report of the committee of the whole house stated that the tenders received by the Electric Lighting Committee in response to the advertisements issued were submitted to Prof. Kennedy, whose views on them were set forth in an exhaustive report, and carefully considered. Certain tenders were recommended for acceptance—namely, those which had been approved of by Prof. Kennedy—and the committee of the whole house adopted the recommendation of the Lighting Committee, and decided to act on it without delay. They submitted the following recommendations for the approval of the Council:—That the tender of the Callender Cable and Construction Company, for the supply and laying down of concentric cables, be accepted for the sum of £12,505 13s 2d., the company binding themselves to maintain the whole of the concentric mains, together with the boxes and accessories as supplied and laid by them for a period of 12 months free of cost to the Corporation. That the offer of the same firm to maintain the cables for a further period of 10 years, on consideration of an annual payment to them by the Corporation at the rate of 10s. per £100, or ½ per cent. on the invoiced value of the work, be also accepted. That either of the following tenders for transformers be accepted, viz.:—Tender of Messrs. Johnson & Phillips, amount £2,996, with the addition of £100, approximately, for cartage and fitting up; tender of the British Thomson-Houston Company, amount £3,340 11s. 3d., subject to the receipt in the meantime from that firm of a satisfactory telegram as to the delivery of the transformers within a specified time. Alderman Meade said the matter had been very carefully considered by the Electric Lighting Committee, who were thoroughly conversant with the urgent necessity there is for having the contract accepted, and the work placed in hand at once. It was absolutely necessary that new cables should be put in, and that the contractors should be urged to go on with the work with all speed, so that the contract would be completed for the coming winter lighting. A committee of the whole house had considered the acceptance of tenders, and they determined that the citizens of Dublin should get the best cables that could possibly be got, and that they should get the lowest possible price. They applied for tenders, and the result of their deliberations, with the assistance of the borough surveyor and Prof. Kennedy, was a recommendation that the tender of the Callender Cable and Construction Company, at the sum of £12,505 13s. 2d., should be accepted. He believed that the cables of this company were the best possible value that could be obtained for the citizens of Dublin. Furthermore, he was informed that these were the cables which the Board of Trade would require to be used in Dublin, because the engineer of the Board of Trade in London had called on Prof. Kennedy, and told him that these concentric cables of the Callender Company should be used, and he even went so far as to say that this would be one of the conditions which the Local Government Board here would put on the Corporation before they allowed them any loans. He moved:—"That the tender of the Callender Cable and Construction Company, for the supply and laying down of concentric cables, be accepted for the sum of £12,505 13s. 2d., the company binding themselves to maintain the whole of the concentric mains, together with the boxes and accessories as supplied and laid by them for a period of 12 months free of cost to the Corporation. That the offer of the same firm to maintain the cables for a further period of 10 years, on consideration of an annual payment to them by the Corporation at the rate of 10s. per £100, or ½ per cent. on the invoiced value of the work, be also accepted; and that the law agent be instructed to prepare the necessary contract." The Callender Company, Alderman Meade continued, had undertaken to complete the work within 18 weeks, while none of the other companies who tendered would engage to complete it within 26 weeks. The question of time in this matter would mean a great deal to the Corporation and the citizens.—Alderman Sir Robert Sexton, in seconding the motion, referred to the saving of time as a most important matter. Although there was a lower tender than that of the Callender Company, the saving of time would considerably make up for the difference of cost.—The resolution was unanimously adopted.—Alderman Meade then moved that the tender of Messrs. Johnson & Phillips for transformers, amounting to £2,996, with the addition of £100 approximately for cartage and fitting up, be accepted. The firm guaranteed delivery within a specified time. The resolution was carried.

Dundee.—At last week's Town Council meeting Treasurer Ritchie submitted the annual report of the gas and electricity departments. In regard to the electricity accounts, the estimated revenue was £6,000; the actual, £5,269 13s. 8d.; leaving a surplus of £269 13s. 8d. The estimated expenditure was £5,284 6s. 7d., the actual being £4,941 9s. 5d., showing a gain of £342 17s. 2d. Adding these two items, the balance of income over expenditure is £612 10s. 10d. Added to a surplus of £715 odd, this made a balance of £1,328 to carry forward. The estimates of the same department for next year, including the large balance of £1,328 4s. 3d. mentioned, less a charge of £381 6s. 7d., the remaining balance due to the gas department, amounts to £7,553 17s. 8d., and the expenditure £7,039 6s. 7d., showing an estimated surplus of £514 11s. 1d. In the year's expenditure provision has been made for a contribution of £1,000 towards the formation of a contingent fund. The Committee advised the reduction of charges for current from 4½d. to 4d. per unit for lighting, and 2½d. per unit for motor purposes. The accounts were criticised by Mr. Brownlee, who thought £1,000 was far too large to devote to a contingent fund, and they were then adopted.

Ealing.—In further reference to the alleged trouble among the electricity works' staff, the Electric Lighting Committee issued a report on its investigations into the affair last week. The report, which recommended that Mr. Recano's resignation be accepted, that Mr. Bush be asked to resign, and that Mr. Saunders should be re-instated, was adopted.

Epsom.—The Urban Council are now issuing a tender for lighting 207 public lights in their district. The advertisement is a formality, as the gas company alone tender; but in the near future the light is expected to be altered, as the Council have purchased a site for erecting public offices, electric lighting station, &c., and have, it is understood, consulted an electrical engineer on the matter.

Glasgow.—Last week at the Corporation meeting, Mr. Maclay, in moving the approval of the minutes of the Electricity Committee, stated that the Committee had now placed the contract for the excavation and concrete work for the electric station at Port Dundas, as well as the contract for the mason work at Pollokshaws. They were resolved to push on the erection of these works without delay.

Last week the Watching and Lighting Committee recommended the Corporation to have 218 gas lamp pillars removed from streets which are now lighted electrically.

Glossop.—Last week a special meeting of the Council was held to consider an electric lighting scheme for the borough. Captain Partington, J.P., chairman of the sub-committee, brought up a report which stated that the scheme submitted comprised an electric station and works on a site adjacent to the Glossop iron foundry, from which centre electric light would be supplied to the whole borough. The cost of working, maintenance, rent of site, and the redemption and interest of the capital would amount to about £1,975 per annum, and the income would be about £2,000, which would give a clear margin of £25 profit. The capital estimated to be expended is about £15,000. Capt. Partington thought they were not justified in spending the money until they were sure they would have enough consumers. It was resolved to adjourn the matter until 29th inst., and in the meantime, a canvass is being made of the district.

Godalming.—The Local Government Board has refused its sanction to the loan of £15,000 asked for by the Town Council for electric lighting purposes. As there was much opposition to the scheme, it is stated that the Board thought it was doubtful whether it could prove remunerative, or even self-supporting, particularly in view of the smallness of the compulsory area. The Council has yet to consider the letter, but the Mayor has expressed an opinion that a poll of the residents will be taken.

Hastings.—After going fully into the matter of the appointment of an electrical expert to report upon the Hastings Electric Light Company's undertaking, the Public Lighting Committee withdrew their proposal to appoint Mr. Grenville, and recommended that Prof. Hy. Robinson be appointed to make the report. This was agreed to by the Council by 19 votes to 1. The Council has approved of the company's proposals to extend mains in a number of roads.

Keith.—The Aultmore-Glenlivet Company, Keith, have just decided to introduce the electric light at their fine new distillery at Forgie. Paraffin is used for lighting purposes at present, and besides being unsatisfactory so far as the light is concerned, is also highly dangerous when the inflammable nature of many parts of the distillery are considered.

Kensington.—The Vestry last week had a discussion on electrical matters, and appointed a Committee to consider the report of the Select Parliamentary Committee. The Vestry has allowed the House-to-House Electric Light Company to erect a trial arc lamp in Kensington Road.

Killarney.—The Killarney Union is unable to find out what profit is being made by the Killarney Electric Lighting Company. The matter was discussed last week, and a resolution was passed drawing the attention of various Members of Parliament and others to the question.

Leeds.—The Bill to confirm the provisional orders granted by the Local Government Board to the Corporation of Leeds for power to create sufficient stock to acquire the undertaking of the Yorkshire House-to-House Electricity Company having been referred to a Select Committee, objection has been taken, on behalf of the Corporation, to the right of the electricity company to be heard before the Committee. The question will, therefore, have to be decided by the Court of Referees.

Leith.—The work of laying mains is being rapidly proceeded with. A sub-committee has been planning the positions for the public lamps. Brackets will be used in Kirkgate.

Liverpool.—The Corporation Bill was before the Parliamentary Committee last week, and the clause asking for power to borrow £200,000 for electric lighting purposes. The Town Clerk pointed out that under the Electric Lighting Act and a provisional order, they were under certain conditions obliged to give a supply to anybody in Liverpool who was entitled to receive it, and to give it up to the required quantity. They could not do that without spending capital, and they could not spend capital without the sanction of the Local Government Board.—Replying to Mr. Hutton, Mr. Fitzgerald and the witness said there were precedents for this clause.—The Town Clerk, answering Mr. Fitzgerald, said it would not be possible to submit a detailed estimate for electric lighting purposes, because in such matters as mains they never knew where they were from day to day.—Mr. Fitzgerald said what was proposed was exactly what was done in Bills relating to gas and water undertakings; they produced a lump and not a detailed estimate. At the present time the Corporation had only £556,355 authorised borrowing powers, and, with the estimated capital expenditure of the present year, the expenditure would be £660,355, and further capital powers were therefore very necessary.—The Chairman intimated that the committee were by a majority against giving the power sought by the clause.—Mr. Fitzgerald asked the committee to give the Corporation sufficient powers, at any rate, to carry them over the present year.—After consultation with his colleagues, the Chairman announced that the committee could not grant the powers which related to electric lighting.

Llandrindod Wells.—The electric light company at Llandrindod Wells want to put up a chimney stack at their works, but the Llandrindod Urban Council are not quite agreeable, for fear an impression may get abroad that there is a manufactory at Llandrindod.

Local Bills in Parliament.—A petition on behalf of the Great Western and London and North-Western Railway Companies, praying to be heard by counsel against the Shrewsbury Electric Lighting Provisional Order, when the committee stage is reached, has been deposited in the Private Bill Office of the House of Commons.

London.—At yesterday's meeting of the City Corporation, Mr. Brooke Hitching was to move in favour of a reference to the Streets Committee (or to a special electric light committee of 12 members) "to consider and report as to the desirability of approaching the directors of the City of London Electric Lighting Company, Limited, with a view to acquiring the whole or part of their undertaking by friendly purchase, and empowering the committee to ascertain on what terms, if any, the directors would sell the undertaking." The law officers of the Corporation have reported that the Corporation has no power to enter into competition with the company, and hence the proposal to buy out the monopoly.

At a recent meeting of the St. George's, Hanover Square, Vestry, a resolution was passed that a special committee of 12 members be appointed to consider the best means of lighting the parish by electricity, and to approach the Electric Light Corporations. A speaker said that the ratepayers had lost a great opportunity of making a good profit for themselves in allowing private companies to get a footing in the parish. The committee appointed includes Lord Hobhouse, Col. the Hon. H. Legge, Mr R. C. Antrobus, L.C.C., and Messrs. Bradford & Macdonald.

Long Eaton.—A town's meeting has requested the Council to oppose the Bill of the General Power Distributing Company, and stated that the town ought to have a municipal plant.

Lowestoft.—At the last Council meeting the Electric Lighting Committee reported that a letter dated April 26th was received from H. S. Foster, Esq., M.P., stating that he had a long talk with Mr. Ritchie on the subject of the electric lighting provisional order, and that the Board of Trade say that the undertakers, in their opinion, have the power already (empowering the Corporation to supply electrical fittings and fixtures, &c.) under the 1882 Act. But if they have not, the Board of Trade advise Mr. Ritchie that the Board of Trade have not the power to give it them by a provisional order. They deny that a meter is a fitting, or in any way analogous, and he thought that the wisest thing is to accept the decision and act upon the advice of the Board of Trade and exercise the power. The Town Clerk reported that he had approved the draft order as altered by the Board of Trade, and had received the bill confirming the order.

Mansion Lighting.—Moor Hall, Kidderminster, has been fitted throughout for electric lighting. A gas engine and dynamo have been put down in an outbuilding. A battery of accumulators is placed in a cellar. There are over 220 lights fitted, some of the fine old gas and other fittings being utilised. The work was done by Messrs. Whittaker Bros.

Mexborough.—The District Council has appointed a committee to go into the electricity supply question.

Morecambe.—There is much disappointment at the delay which has arisen in carrying out the contract for the installation of electric light. At last week's meeting of the District Council it was resolved to approve the Electric Lighting Committee's recommendation "that Messrs. Thomas Parker, Limited, be allowed to deliver the steam dynamos and exciter, which Mr. Parkinson has tested, and which he has reported as not being in accordance with the contract, subject, however, to the question of compensation standing over." The Local Government Board has sanctioned the loan of £8,821 for electric light purposes, being the sum of £10,000 applied for, less a deduction of £1,144 10s., the sum awarded to the Council in respect of defective cables, and £34 10s. for articles not forthcoming in connection with the purchase of the portion of the plant of the Morecambe Electric Light and Power Company, Limited, for which the Local Government Board sanctioned a loan of £3,900 on September 20th, 1897. Mr. Parkinson, the electrical engineer, has been authorised to engage the necessary additional staff, including assistant electrical engineer, engineer and switchboard hand, engine driver, battery man for three sub-stations, two trimmers, fireman, and labourer. At the Council meeting Councillor John Brown said they had got the first set of engines at the works, and the resident engineer expected being ready last Monday to switch on to the arc lights on the Front.

New Brompton.—In the High Street of New Brompton standards have been erected for the purpose of supplying the streets with electric light; but up to the present the electric light has not permanently appeared. It is stated that the present lamps are not quite suitable for street lighting, but that others will shortly take their place, and then the full light will appear.

Newcastle.—Last week Mr. Colamb and Dr. Hopkinson paid a visit to Newcastle to inspect the district, and to take notes for the purpose of their reports on cable and electric traction. Dr. Hopkinson is stated to have thought that the Corporation ground in City Road would suffice for one power station to supply current for the whole of the lines, and plant for 5,000 H.P. could be installed there.

Newport (I.W.)—An application from Edmundson's Electricity Corporation, asking the Council to sanction application for a provisional order on condition that they supply current for lighting the streets and public buildings at 4d. per unit, has been referred to the Finance Committee.

Newington.—According to our contemporary, the *Contract Journal*, the following tenders were submitted for the supply and erection of engines, dynamos, and public lighting plant at the new electric lighting station in Penrose Street for the Vestry of St. Mary, Newington:—

Sharp & Piper	£9,575
Siemens Bros. & Co., Limited	9,375
Brush Electric Company	9,090
Johnson & Phillips	8,975
Crompton & Co.	8,802
Fowler & Co., one section only	5,200

The tender of Messrs. Johnson & Phillips is recommended for acceptance.

Northwich.—Applications for current are coming in so well that the supply company is about to make further extensions. One main, three-quarters of a mile long, is to be laid to supply "The Brockhurst," Sir Joseph Virdin's residence. The Guardians decided on Saturday last to light the workhouse, and Messrs. Ames, Garrard and Co. have been asked to prepare a specification for the work. Feeder mains are to be laid from the electricity works to the Bull Ring, a distance of a mile. The supply company has now running two 100-B.H.P. Crossley engines, two 60-kilowatt dynamos, and one 19-kilowatt balancer, by Messrs. Laurence Scott & Co., Limited, with a 200 ampere-hour battery by the Chloride Syndicate, Limited. Lamps equivalent to 2,500 of 8-C.P. have been applied for, and about 2,050 connected to the mains.

Petersfield.—The District Council decided, at its meeting on 16th inst., by six votes to two (both of the latter being votes of directors of the local gas company, who urged the Council to await the result of the new incandescent gas burner), to instruct Mr. A. H. Preece, of Westminster, to furnish a report as to the practicability and cost of an electric lighting scheme.

Plumstead.—The Vestry has informed the Woolwich District Electric Light Company that it has decided to oppose any application for a provisional order to extend their supply to Plumstead.

Poplar.—The Board of Guardians do not agree to hold back their electric lighting scheme until the Poplar District Board of Works' undertaking is put down. We referred to this matter last week.

Portsmouth.—The principal business at last week's Council meeting was the presentation by Alderman G. Ellis, chairman of the Electric Lighting Committee, of the balance-sheet and revenue accounts for the year ending March 31st last. The receipts were as follows:—Private consumers, £10,833 16s. 3d.; public lighting, £4,645 19s. 2d.; sales by contract, £144 3s. 1d.; meter rents, &c., £641 4s. 6d.; total receipts, £16,265 3s. On the other side, the expenditure has been:—Generation of electricity, £5,309 10s. 5d.; distribution ditto, £1,006 15s. 7d.; repairs and renewals, £1,454 2s. 6d.; rents, rates, and taxes, £397 2s.; management expenses, £1,177 18s. 11d.; law charges, £11 15s. 4d.; interest on overdraft, £112 9s.; total expenditure, £9,469 13s. 9d. This leaves a gross profit of £6,795 9s. 3d. on the year's working. Of this sum £6,750 is carried to net revenue, leaving a balance of £45 9s. 3d. to be carried forward to next year's working. Out of the £6,750, the Committee have paid £3,180 19s. 4d. for interest on borrowed capital, and £2,793 13s. 7d. towards redemption of loans, leaving the sum of £776 to the good. With regard to the capital account, the total amount sanctioned to be borrowed is £142,000. Of this sum £119,651 has already been borrowed, leaving a sum of £22,349 yet to be called up. Out of this gross sum of £119,651 already borrowed, there has been expended £112,174 7s. 10d., which has been disbursed as follows:—Land and building, £14,009 15s. 6d.; machinery, mains, meters, transformers, &c., £95,620 18s. 5d.; engineers' commission, £2,196 5s.; furniture expenses, &c., £347 8s. 11d.; total, £112,174 7s. 10d. Alderman Ellis, in moving the report, said that he was disappointed with the revenue made. In the first part of the year they would remember that permission was given to reduce the price of the current ½d. per unit, and the Committee felt that they would have a large influx of customers, which would more than compensate. The customers did come, by dozens and by hundreds, but unfortunately for them and for the nation, the strike and lock-out upset all their plans, and prevented them taking any customers on up till January 1st of this year. To show them that they would have progressed, he would mention that from January 1st up to that morning the increase of lights amounted to 5,872. Every one of these might have been joined up last year had they had the plant. But there was another point. When they reduced their price, they practically brought their revenue down to 3¾d. per unit sold, because they sold the units for street lighting at a much smaller price than that paid by the ordinary consumer. Portsmouth was almost the lowest in the whole of the United Kingdom, and he thought it must be very satisfactory to the inhabitants to know that while they were making a profit of £6,795 gross, they charged as low as or lower than any other town in the United Kingdom. What had they done with the profit? There were the extraordinary charges due to the lock-out, £654 for replacing the arc mains in the town, which were not strong enough, £112 interest on bank charges, £3,180 interest on the loan, and £2,793 for the sinking fund. There was a net profit of £820 16s. 4d. During the past few weeks they had had a good deal of criticism upon the balance-sheet, and they had been told by certain people that they ought to have a large fund for maintenance. He would agree with that view if they were dealing with the gas company, water company, or an electric light company. But they were not dealing with anything of the sort. He would go further, and say that if they were dealing with the great city of Glasgow or the large city of Leeds, he would agree. But the case of Portsmouth was different. Why did he make this difference?—Because Glasgow borrowed money in ordinary stock for 42 years. Leeds took over a company and paid £2 for every pound paid, and the Local Government Board had permitted them to borrow the money for 42 years. That was not the case in Portsmouth. They had borrowed the money for engines for 15 years only. And if anyone said that the engines would be worn out in 15 years, and would have to be replaced by new ones, he did not know anything about it. It was not necessary to provide a sinking fund of any dimensions for renewals. To ask them to pay in 15 years the sinking fund and interest, and to hand to the Council on that date a sum equivalent to the sum equal to rebuild the whole thing again, would be monstrously hard on this generation, and would be totally unnecessary. It was the consensus of opinion throughout the country that there was no necessity for a renewal fund sufficient to replace the machinery. They were quite at liberty at the end of the 15 years to re-borrow the money, and allow the generation of that date to pay their own charges for their own benefits. He moved the adoption of the balance-sheet. After discussion the report was adopted.

Rhyl.—Mr. H. W. Buddicomb, Penbedw Hall, Nannerch (N.W.) has written to the District Council stating that he noticed that at most seaside and holiday resorts the authorities were adopting the electric light for public lighting purposes, and he asked, in the event of the Council not having powers of their own for supplying electric light, whether they would approve of an application by him for such powers, and agree to take electric light for illuminating the sea front. He also asked their consent to an application for laying down a system of electric tramways. The letter was referred to the Road Committee for consideration and report.

Russia.—A company has just been formed in St. Petersburg, with a capital of six million roubles, to be known as the Russian Union Electrical Company. The new concern will acquire and take over the central electric lighting station in the town of Riga, and also propose to establish similar stations in other Russian towns.

Saltburn.—Last week the Urban Council had before it the report of Mr. Burstall (Burstall & Monkhouse), *re* electric lighting. It is pointed out in the report that Saltburn is smaller in area and population than any town in which a public electric lighting installation is already at work, and it was therefore difficult to estimate the number of lamps required. For a specified area in the first year there might be a demand for 1,800 8-C.P. lamps, and in the second year 2,500 to 3,000. He advises, as suitable for a site, land lying to the west of the Whitby branch railway. Low tension continuous current system, with 250 volts at consumers' terminals, is recommended. The dynamos would be driven by 50-H.P. steam engine. The utilisation of water-power at Marske mill is out of the question. Capital expenditure is estimated as follows:—Generating plant at station, £3,200; buildings, £1,500; mains and fixings, £2,500; public lighting, £500; meters and other apparatus, £250; legal and professional charges, £1,000; total £7,000, plus cost of land; 7d. per unit would be charged for current and public lighting at 3½d. per unit. The total income is put at £834 per annum, working expenses, £573; gross profit, £261. Interest and sinking fund would cost £460 for the first year, leaving a deficit of £199. The matter is to be laid before the ratepayers, who are to vote upon it. A provisional order will be applied for in November.

Shoreditch.—The Lighting Committee reported at the Vestry meeting on Tuesday evening that Mr. H. E. Kershaw had been re-appointed chairman of the committee. The committee had had under consideration the correspondence between the chief electrical engineer and the contractors, on the subject of the automatic gear to the Willans engines, which had not proved to be satisfactory, and which the contractors had agreed to take back. At the suggestion of the committee the Vestry approved the return of the gear as sanctioned by the consulting engineers. Mr. Kershaw, chairman of the committee, in moving the adoption of certain alterations in the charges for electric current, stated that the reductions amounted to 25 per cent. to the average customer. The chief electrical engineer (Mr. Russell) had submitted to the committee an estimate of the liabilities and income for the next 12 months. That estimate was based upon the reduced rates, and showed that they would have a substantial surplus of income over expenditure to the extent of over £4,000. Thus the committee, who were practically unanimous on the reductions, were justified in asking the Vestry to approve the projected new charges. Among other changes, the committee proposed to reduce the charge for current from 6d. to 5d. per unit for the first two hours, and to 2d. afterwards, whilst consumers would have the option of being charged a fixed rate of 4½d. per unit. It was also intended to abolish meter rentals, to reduce the charge for public lighting from 5d. to 3½d. per unit, and the charge for current for motive power purposes to 2d. per unit for all hours, all alterations commencing on the 26th inst. Mr. Winkler moved that the proposals should stand over for two months; but after some discussion, the Vestry adopted the various recommendations made to effect the alterations in the scale of charges. On the motion of Mr. Kershaw, the Vestry Clerk was instructed to supply the members with copies of the report of the Parliamentary Committee on the supply of electrical energy, in order that the Vestry might consider what action should be taken in the matter of opposing the clauses in that report.

Shrewsbury.—The Council has authorised the Town Clerk to make application to the Local Government Board for sanction to the raising of a loan of £35,000 to complete the purchase of the undertaking of the Shropshire Electric Light and Power Company, Limited.

The Board of Trade have issued copies of the new provisional order, which they have just forwarded to the Corporation of Shrewsbury, authorising them to supply electricity throughout the area of their borough.

South Africa.—The electrical engineer of the Bulawayo Electric Light Company (Mr. J. H. Meikle), has lately been on a tour in the southern colonies, and had inspected the electric lighting plants in the various towns. Those at Johannesburg and Durban struck him as being the most up-to-date installations. They were both high tension alternating, the same as at Bulawayo. The only plant with accumulators was that at Cape Town, which was at least five years old, and had given trouble from the day it started. He considered that at Bulawayo they had a thoroughly efficient and up-to-date installation. It is interesting to note that the maximum charge for house lighting is 2s. 6d. per unit for small consumers, reducible to 2s. for large consumers, churches, Government buildings, &c., pay 1s. 7d. per unit.

Stockport.—Mr. A. J. H. Carter, late clerk of works, and chief assistant engineer for the Brighton Corporation, has been appointed clerk of works for the electric light installation in course of erection at Stockport. There were 54 applicants for the appointment.

St. Pancras.—The Electric Lighting Committee reported at the Vestry meeting on Wednesday, that they had instructed the chief electrical engineer to make experiments with a view to the utilisation of the surplus steam from the refuse destructor for the purpose of driving the electric light engines. Mr. Sydney W. Baynes, the engineer, had carried out a number of tests, but owing to the irregularity in the supply of the steam, it was not possible to depend upon it for the particular purpose in question. It had therefore been decided to abandon the idea of utilising the steam for electric lighting purposes. The report was passed without comment. It was resolved that the Vestry should be represented on the Municipal Electrical Association.

Swinton and Pendlebury.—The District Council will not allow the Salford Corporation to supply electric current to Swinton Cottage, Swinton Park, but the Council will be itself going into the matter of electric lighting shortly.

Taunton.—The Electric Light Committee has reported that the total connections made during May were equivalent to 623 8-C.P. lamps.

Teddington.—The District Council has agreed to confer with the Twickenham Council before coming to any decision regarding the proposal of Edmundson's Electricity Corporation to form a company for lighting the two districts.

Towyn and Aberdover.—A Colwyn Bay resident recently offered to prepare a scheme and estimates for electric lighting, and the District Council referred the matter to a committee.

Walsall.—The Midland Electric Corporation for Power Distribution has notified its intention to omit Walsall from its proposed area of supply.

A tender has been accepted for laying the foundations for the new engine and dynamo at the generating station.

Winchester.—The works of the Winchester Electric Light and Power Company are now completed. They will be formally opened on the 30th inst., and invitations have been issued.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barking.—The engineer has submitted to the District Council plans, estimates, and report, upon his scheme of light railways from Barking to Beckton, and has attended before the Lighting Committee to explain details. The committee had resolved that such scheme be approved, and that the clerk supply a copy of such estimate and report, as well as of the draft order and book of reference, to each member of the Council. It was resolved that Mr. W. C. C. Hawtayne be appointed electrical engineer, to act in conjunction with Mr. Barker, in connection with the light railways scheme, upon terms to be subsequently arranged. The Light Railway Commissioners have notified that they will hold an inquiry on the 23rd inst.

Blackpool and Fleetwood.—The Board of Trade inspection of the new electric tramroad connecting Fleetwood and Blackpool was expected to take place this week. Open cars will be used during the summer months, and already several trial runs with these have been made, the distance between Uncle Tom's Cabin, Blackpool, and the centre of Fleetwood being covered in 23 minutes.

Bristol.—Last week in the Commons the Bristol Tramways (Electrical Power, &c.), and the Bristol Tramways (Extensions) Bills were read a third time.

Cardiff.—The Electric Tramways Committee held a special meeting last week to consider what steps should be taken with regard to the proposed electric trams now that Parliament had granted the powers asked for by the Corporation. After discussion it was decided that nothing further could be done in the matter of the proposed trams until the question of overhead wires *v.* conduit system had been settled. A deputation will shortly report on the question.

The City and South London Railway.—According to the *Times*, in consequence of representations from Mr. Austin, the President of the Board of Trade has promised to make inquiries concerning the alleged overcrowding on the City and South London Electric Railway. At the same time steps will be taken to ascertain whether there is any foundation for the complaint that insufficient means of ingress and exit are provided for passengers at the King William Street and Stockwell stations on the said line.

Enfield.—Mr. B. Godfray, solicitor, and Mr. J. W. Ransome, engineer, appeared before a committee of the District Council last week, representing the company which is promoting the light electric railway scheme (overhead trolley) for this and the surrounding district. It is stated that the Light Railway Commissioners will hold an inquiry on July 13th. It has been decided at present to proceed with only the lines running from Wood Green to Enfield, from Wood Green to Tottenham, and from Enfield to a junction with the lines of the North Metropolitan Tramways Company in Hertford Road.

Gillingham.—At the fortnightly meeting of the Gillingham Urban District Council (16th inst.) the question of electric trams was again discussed, and the clerk (Mr. F. C. Bowlen) reported the favourable result of the adjourned inquiry held by the Light Railways Commissioners as to a scheme for light railways in the district.

Glasgow.—The general manager of the Tramways Department (Mr. John Young), last week submitted to the Tramways Committee a statement of the revenue and expenditure account for the year ending May 31st, subject to final audit. Though these figures have no direct connection with electric traction, they will be interesting in view of the great attention which electrical men have been and will be giving to the Corporation trams here. The statement showed that the gross revenue amounted to £394,111 12s., and the working expenses to £293,594 11s. 9d., leaving a balance of £100,517 0s. 3d as compared with £84,596 3s. 1d. for the preceding year. The fixed charges, such as rent of Govan lines, interest on capital, statutory sinking fund, and payment of £9,000 to the Common Good, amounted to £38,465 0s. 9d., leaving a balance of £62,051 19s. 6d., to be deducted for depreciation and to be added to the renewal and general reserve funds. The total number of passengers carried during the year was 106,864,437, as compared with 98,966,638 for the preceding year, 86,462,594 for the year ending May 31st, 1896, and 57,104,647 for the first 11 months ending May 31st, 1895. The balance of revenue, after deducting working expenses, was £84,596 3s. 1d. for year ending May 31st, 1897, £83,267 7s. 11d. for year ending May 31st, 1896, and £35,699 3s. 3d. for 11 months ending May 31st, 1895.

The Great Northern and City Railway.—We understand that the company has succeeded in effecting arrangements with all the opponents to the Bill of the present session. This Bill will now pass as an unopposed measure through its remaining stages in the House of Commons.

Greenock.—The Greenock and Port-Glasgow Tramways Company are contemplating the introduction of electric traction on the tramway system. The present lease is almost expired, and it is stated that, should it be renewed, application will be made for Parliamentary powers.

Harrogate.—The Town Council last week had a discussion with reference to the proposed light tramways from Harrogate to Knaresborough, and it was resolved that the decision of the committee averse to the scheme be endorsed, Harrogate not being adapted for tramways.

Hendon.—The committee appointed by the District Council to consider the project of the London, Edgware, Hendon and Barnet Light Railway has reported that the promoters proposed to construct a line along the Edgware Road to the Old Church, Edgware. The gauge would be 4 feet 8½ inches wide—double in parts—and presumably with poles in the centre of the road for carrying overhead wires. It was proposed to acquire three acres of land adjoining Edgware Churchyard for works. The promoters understood to carry passengers, cattle, stone, minerals, fish, &c., the rates to be subject to revision triennially. The committee came to the conclusion that although better means of communication were required, they did not consider the proposed scheme was the best for the purpose. The District Council has adopted the report.

Johnstone.—The British Electric Traction Company have laid several communications before the Town Council relative to connecting Johnstone with the proposed tramway to Glasgow. Provost Thomson said he would give the proposed tramways the most uncompromising opposition. The Council has agreed to meet with the representatives of the company with a view of receiving information *re* the proposals.

Light Railways and Tramways.—In the House of Commons last week, in reply to Mr. Hazell, Mr. Ritchie said: There is nothing in the Light Railway Act to prevent the consideration of light railway schemes in urban districts. The Light Railway Commissioners and the Board of Trade have ample powers to impose on promoters as a condition precedent to entertaining an application powers of purchase as large as those defined in the Tramways Act of 1870. The Light Railway Commissioners have the scheme promoted by the Metropolitan Tramways | and Omnibus Company, Limited, under consideration, but, as they have an independent jurisdiction, I am not in a position to say what steps they will take with regard to it.

Limerick.—A committee of the whole house of the Corporation last week had the following items under consideration:—Electric trams, &c.—Letters from (1) H. Bickerdike, Montreal, proposing to introduce the "American electric trolley system" into the city, on terms to be arranged; (2) Mr. J. E. Palmer, Ballybrack, Co. Dublin, applying for a lease for 150 years of the sole right to construct, equip, maintain, and work electric tramways in the city, and proposing certain routes for which the lease is asked; and (3) M. Zeitz, Hamburg, offering to supply cars, completely fitted out, for the overhead system of electric traffic. In connection with above to consider advertisement of the Limerick Electric Tramways Company, Limited.

Liverpool.—The laying of the rails for the experimental electric line from Castle Street to the Dingle is on the eve of completion, and the cars will soon be given a trial.

London United Tramways Bill.—On Friday last this Bill was again before the Select Committee of the House of Commons. Evidence against the Bill was given on behalf of the Middlesex County Council, and by Mr. J. W. Benn on behalf of the London County Council. Mr. Benn said that the L.C.C. most heartily joined with the Hammersmith Vestry in opposing the attempt to take away from a local authority the right of veto conferred upon it by Parliament. Under the Tramways Act of 1870 it was provided that local authorities should have power to purchase the lines at the expiration of 21 years. In the case of the London County Council that period had been modified in several instances, so that the lines should become purchaseable about the same time. In 1890, 4½ miles came under the purchase clause. Since then the London County Council had become the owners of about 68 miles out of the 114 miles which would become purchaseable under the Act. The London County Council were very anxious that any form of traction adopted should, as far as possible, accord with the system which it was hoped presently to determine upon as the best. It was very desirable that the veto should be maintained especially in the

case of the London County Council, which would presently be ground landlord so to speak, of the complete tramway system of London. In three cases the Council had given its consent to the use of electricity on London lines. In his opinion, it would be a very serious thing to allow a tramway company to erect a generating station and supply electricity in bulk except under the same regulation which applied to electric lighting companies.

On Monday, when the consideration of the Bill was resumed, Mr. J. W. Benn, chairman of the Highways Committee of the London County Council, said the scheme of the company was excellent, but the promoters ought to sacrifice a little in order to meet the wishes of the county of London.—Mr. Pope, in addressing the committee on behalf of the London County Council, said the object of the County Council was not to impede the growth of electrical tramways, but to preserve its authority over such undertakings within the county of London.—Mr. Littler, replying on behalf of the promoters, said they were quite prepared to leave the question as to whether the overhead or the conduit system should be applied to King Street west to the decision of the Board of Trade, and, inconvenient as it would be to have a part overhead and part culvert system, they were quite willing to work the small portion of the proposed line within the county of London by the latter method. In America, electric tramways on the overhead system had increased from 1,200 miles to 14,000 miles, whilst the mileage on the culvert system had decreased. Counsel read reports on the trolley system from Belfast, Glasgow, Sheffield, Birkenhead, Liverpool, Manchester, and Dublin to show that the consensus of opinion was greatly in favour of the overhead system as opposed to the culvert system.—The committee decided, according to the *Times* report, that the preamble of the Bill with regard to tramways No. 6 and 7 (the Boston Road and the Kew Bridge to Hounslow sections) was proved, but did not impose upon the promoters any condition as to simultaneous construction. The committee were of opinion that the preamble was not proved with regard to tramway No. 8 (the Ealing section), and were further of opinion that a sufficient case had not been made out for overriding the principle laid down by Parliament requiring the consent of the local authority, and therefore Clause 27 (repealing the veto) must come out of the Bill. The committee were strongly of opinion that the congested state of London made the speedy adoption of electric traction on tramways necessary, and they earnestly trusted that arrangements might be made between the London County Council and the promoters by which the benefits of one system or another of electrical traction might be secured to the public at the earliest possible date. With the view of enabling the promoters and the London County Council to discuss the matter so far as it related to the lines within the county of London the consideration of clauses was deferred.

The Bill was before the Committee again on Tuesday, Mr. Earle, for the Middlesex County Council, urged, says the *Times*, that that body should be put on the same footing in the matter of veto as the London County Council, so that they could insist upon the same system of traction being used in Acton as was employed in the county of London. Mr. Coward replied that the promoters had met the London County Council, but had not been able to arrive at an agreement, and a further consultation had been arranged. The promoters had suggested to the County Council that the tramways which had been acceded to by the committee should be worked by accumulators, but the Council had not yet had sufficient time to consider the proposal. The promoters did not know whether the County Council would accept the suggestion or not. The chairman explained that the committee in giving their decision had not intended that the agreement to be arrived at between the County Council and the promoters should be embodied in a clause to be submitted to the committee. Their desire was merely that the parties should agree. Mr. Earle maintained that the Middlesex County Council had a right to be so heard, as they were the persons who, under the Act of 1888, had to pay the expense of maintaining the roads. The committee decided not to sanction a dual authority, and therefore rejected Mr. Earle's application. The committee then proceeded with the consideration of clauses.

Our contemporary says that the committee on Wednesday presented a special report to the House of Commons stating that, in their opinion, a sufficient case had not been made out for overriding the principle laid down by Parliament in the London United Tramways Order, 1895, which requires the consent of the London County Council to the use of mechanical power upon tramways in the County of London, and that they had, accordingly, rejected Clause 27 (repeating existing provisions as to motive power), so far as it affects the County of London; but they are strongly of opinion that the congested state of London makes the speedy adoption of electric traction on tramways necessary, and they earnestly trust that arrangements may be made by the London County Council with the London United Tramways Company whereby the benefits of one system or another of electric traction may be secured to the public at the earliest possible date.

Manchester.—The Manchester Carriage and Tramways Company's Bill is to be opposed before the House of Lord's committee by the Manchester Corporation, the Stalybridge Corporation, the Eccles Corporation, Salford Corporation, Levenshulme Urban District Council, Moss Side Urban District Council, Stretford Urban District Council, Withington Urban District Council, Heaton Norris Urban District Council, Stockport Corporation, Aston-under-Lyne Corporation, Denton Urban District Council, Gorton Urban District Council, Failsworth Urban District Council, Oldham Corporation, and the Swinton and Pendlebury Urban District Council. The London and North-Western Railway Company and the Lancashire and Yorkshire Railway Company have also petitioned against the measure.

At a meeting of the special committee of the Corporation *re* tramways, held on 20th inst., a recommendation to be made to a special meeting of the City Council convened for Wednesday last, was approved. For some time past a sub-committee has been in negotiation with the various outside local authorities in regard to the taking over of the tram lines in their areas by the Corporation, and the result was the drawing up of an agreement. By this agreement the Corporation will next session apply to Parliament for authority to lease the tramways from the local authorities, and to work the lines "either with animal or mechanical power, including power, with the consent (hereby granted) of the local authority, to equip the tramway for electric traction on the overhead system, in the same manner as tramways within the city of Manchester shall hereafter be equipped by the Corporation on that system." This application is to be supported by the local authorities, who will give the Corporation a 21 years' lease at an annual rental, the Corporation to pay all local rates in respect of the tramways. If the terms of the lease are not settled by mutual agreement, the Board of Trade, or a referee appointed by that Board, will decide. These arrangements do not apply to Withington and Moss Side, where the local authorities own their own tramways. An endeavour is being made, however, to conclude arrangements by which these lines also shall be leased to the Corporation. The committee has confirmed the report of the sub-committee, and approved of the terms of agreement.

At Wednesday's special Council meeting it was decided to confirm the committee's proceedings, the lines to be reconstructed so as to be worked by electricity. An amendment after the words "electric traction," to substitute the words "on any system which may hereafter be decided by the Corporation," was lost.

The Metropolitan Railway and Electric Traction.—The Metropolitan Railway Bill came before the Lord's Committee on Wednesday. The Bill under which powers are sought for the purchase of additional land for ventilation purposes was opposed by various vestries. Mr. Littler in opening the promoters' case, said there was a prospect of electric traction being adopted on the railway in the near future, and the promoters were now acting upon the report of the Board of Trade, which recommended as a temporary measure that a few more openings should be constructed as a satisfactory means of ventilation which might afterwards be useful in the event of the adoption of electric traction. The time had not arrived when it would be wise to substitute electric traction for the present means of locomotion, but arrangements were in process with the District Railway for experiments to that end. Colonel Bell, the chairman of the Metropolitan Company, said that arrangements had been concluded with the Metropolitan District Company for the experiments with electricity. Sir Benjamin Baker stated that the electrical experiments referred to would occupy at least 12 months.

Paisley.—Mr. Teague, the Council's electrical engineer, recently submitted a report prepared by him on the proposed construction of electric tramways by the British Electric Traction Company, Limited. A sub-committee was appointed to consider and report upon it. At a meeting of the sub-committee the report was laid on the table, and it was unanimously agreed to recommend that, in the event of the electric tramways being constructed, the overhead system of traction be adopted, and that in the carrying out of the work it should be done by the Corporation under the direction of the undertakers. Bailie Nicolson moved, at the Council meeting last week, that the minute be remitted for further consideration. The motion was agreed to.

At a meeting of the sub-committee of the Renfrew County Council last week, a conference was held with several members of the Paisley Town Council and the Tramways Committee anent the proposed electric tramways between Paisley and Johnstone. The convener having stated the object of the conference, Councillor Goudie explained the position of the Paisley Town Council regarding the proposals of the British Electric Traction Company to construct electric tramways in that burgh, and also on Beith Road between Paisley and Johnstone; and Mr. Mann having similarly explained the position of the District Committee, a general discussion ensued and interchange of views. Mr. Sellon, of the British Electric Traction Company, afforded information as to the project of the company, and in reply to queries by members of committee stated that in the meantime they proposed to lay only a single line of rails, with passing places; and in reply to a further question by the convener, he stated definitely that the company would not undertake to lay a double line of rails, even on the road between Glasgow and Paisley, until the company were satisfied that their traffic could not be accommodated by a single line. The committee, after consideration, agreed that the granting of the order to the Traction Company should be strenuously opposed.

Sheffield.—It will be remembered that the City Council recently instructed Mr. F. Nell, of London, to report upon the advisability of utilising the compensation water of the city reservoirs to produce electricity for traction purposes. Mr. Nell's report was last week before the Tramways Committee. In it he discusses the amount of power available at the Damflask, Rivelin, and Redmires reservoirs, and in the case of the first two gives the approximate cost of utilisation, and in regard to the latter no power could be obtained. The committee, after considering the report, passed the following resolution:—"That this committee, having considered the report of Mr. Nell, the expert, which confirms in all respects the reports presented to this committee by the water engineer and the electrical engineer, is of opinion that as at present advised it is economically impracticable to utilise the compensation water at the disposal of the Water Committee for generating electricity for electric tramway traction."

Stoke-on-Trent.—The Board of Trade has written to the Town Council respecting the dispute existing between local authorities interested and the British Electric Traction Company as to the

setts to be used for paving the tramways. The company applied under Section 33 of the Tramways Act, 1870, for the appointment of a referee to settle the matter in difference. The Council has replied asking to be represented before such referee.

Surrey Light Railway.—The London United Tramways Company have withdrawn their application for a light railway from Kew to Kingston and Hampton Court over Richmond Bridge. The intimation was given the Town Clerk of Richmond by letter on Wednesday last week. The action of the company is due to the amount of opposition they have met with the Richmond Corporation, Richmond Vestry, private owners, and large landowners, including the Duke of Cambridge and Lord Charles Beresford, the Ham District Council, the Kingston Corporation, Kingston Bridge Commissioners, Hampton Wick District Council, and the County Councils of Middlesex and Surrey, the whole of the public authorities covering the proposed route were opposed to the order being granted. The withdrawal of the scheme follows but a few days the abandonment of the Bill in Parliament by the same company to carry a tramway with overhead electric traction over Kew Bridge, connecting Richmond with Brentford and joining the starting point of the light railway.

Sunderland.—Last week the Corporation tramways deputation journeyed to the Continent to inspect tramways in various cities.

Swansea.—The sub-committee on tramways has considered whether any concession should be made to the British Traction Company in consideration of their widening certain streets, and proposes that the Corporation should make the same offer as in the Act of 1887, and provide the £22,000 required for the purpose on loan at 3 per cent. interest for 30 years. The Council, after discussion, resolved to favourably consider the offer if the security was deemed by a sub-committee sufficient.

Waterford.—The preliminary work in connection with the new electric tramway in the city of Waterford has not yet commenced. The promoter who has got running powers from the Corporation is Mr. Palmer, Dublin.

West Derby.—Messrs. F. J. Leslie & Co. submitted plans, &c., to the Parish Council of a light railway which their clients, the Lancashire Light Railway Company, Limited, were applying for powers to construct between Liverpool and Prescot, the intention being to unite by a light railway or tramway worked by electricity the St. Helens tramway, which terminates at Prescot, with the Liverpool tramways. The Council was asked to support the suggestion as to the proposed tramway to connect St. Helens with Liverpool over that part of the high road commencing at the city boundary and going in the direction of Prescot. The Council sees no objection to the proposal, but has asked for fuller information.

Yarmouth.—The Electric Lighting Committee has had a conference with a deputation from the Yarmouth and Gorleston Tramway Company with regard to the working of the tramways by electricity. The conference was adjourned.

TELEGRAPH AND TELEPHONE NOTES.

The National Telephone Company and the St. James's Vestry.—With reference to the communication recently addressed by the National Telephone Company to a large number of their subscribers in the West End, whose telephone lines have been disconnected as a result of the recent fire in Heddon Street, in which an attempt was made to throw the responsibility for this interruption in the telephone service upon the St. James's Vestry, Mr. T. H. Munsey, the vestry clerk, writes to the *Standard*, stating that the facts are these:—"In March, 1897, the company made application to the Vestry for permission to lay pipes in Regent Street in accordance with plan submitted, to which the Vestry resolved to give their sanction, on condition that the company entered into the usual agreement, embodying payment of a nominal rent and power to require the removal of the pipes on six months' notice. The draft agreement was submitted for the company's approval, but they refused to accept it (although they had entered into a similar one with respect to Piccadilly in the previous year), and altered the draft so as to extend it to a general permission to lay pipes in the future. Considerable correspondence ensued, and when at length the draft agreement was returned it was discovered that the plan which was originally submitted and attached to the draft had been retained by the company. After repeated applications, an entirely new plan was sent in to be attached to the agreement, when it was found that this plan differed very materially from that sanctioned by the Vestry, and on getting back the original plan this also, on examination, was proved to have been considerably varied since passed by the Vestry. Under these circumstances, the Vestry declined to proceed further in the matter until the company had given a satisfactory explanation of the alterations which had been made in the plans. The explanation given was not deemed to be satisfactory, and the Vestry accordingly, in July last, having regard to this fact and to the delay of the company in entering into the agreement, and to the great inconvenience and delay which would then have been caused in the repaving of Regent Street, about to be commenced, by the laying of the company's pipes, withdrew their consent to the laying of the pipes in the thoroughfare in question. Amended applications, dealing with various parts of the parish, were afterwards submitted for the Vestry's consent, but, after the experience gained, the Vestry declined to consent to the same, the company not making any proposals for the benefit of the ratepayers, and, in fact, declining to pay any material rent for the privilege sought."

If the above statements represent the actual facts of the case, it would seem that the National Company is not going the right way to work to make friends.

The New Gotland Cable.—The c.s. *H. C. Oersted* has returned to Henley's Telegraph Works, North Woolwich, after laying the new Gotland cable for the Swedish Government. This cable extends from Ahr, in North Gotland, to the Island of Sandö, thence to Hufvudskar, thence to the Island of Ornö, and thence finally to Dalarö. From the cable station on the southern side of Ornö, an aerial line, some miles in length, is about to be built to the northern side of the island to connect with Dalarö, and thence by the existing system of aerial lines to Stockholm. One main object of the new cables just laid is to connect the various lighthouses on the islands in question with the Swedish mainland. It may be mentioned, as an interesting fact, that telephonic communication was successfully established between Ornö and Ahr (the cable ends at the intermediate stations being joined together), through some 80 knots of cable. The core is $\frac{107 \text{ lbs. Cu.}}{150 \text{ lbs. G.P.}}$ per knot. During the cable-laying operations, considerable care had necessarily to be used in navigating the ship through the numerous rocky islets and shallows which stud the Baltic coast at this part; and some difficulty, moreover, was experienced from fog, but the submersion of the cable was effected without a hitch. The expedition was in charge of Mr. Theophilus Smith, Messrs. W. T. Henley's submarine engineer, while Mr. J. F. Hall had control of the electrical testing and speaking arrangements.

Stockport Telephones.—The Corporation has declined to grant to the National Telephone Company, Limited, permission to lay pipes or conduits beneath certain main streets of the borough for the purpose of placing telephone wires underground. The ground of refusal is that the company does not possess statutory powers, as in the case of tramways and electric light undertakings.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1898 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Mole-St. Nicholas-Caimanera	June 10th, 1898 ...	...
Caimanera-Santiago de Cuba	June 10th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Bolama-Bissao	April 12th, 1898 ...	June 21st, 1898.
Maranham-Para	„ 17th, 1898 ...	...
Hong Kong-Manila	May 3rd, 1898 ...	...
Loanda-San Thomé ...	June 3rd, 1898 ...	...
Mozambique-Lourenco Marques	June 14th, 1898 ...	June 20th, 1898.
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Cartagena-Barranquilla ...	July 4th, 1896 ...	...
Volo-Larissa	June 8th, 1898 ...	June 17th, 1898.

Yarmouth Telephones.—Last week the Town Council passed a resolution in favour of municipal control of the telephone service which it was said might be trebled and the cost reduced.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barnet.—June 24th. The Lighting Committee want tenders from firms willing to undertake such installation for lighting the district by electricity. Particulars at the Council offices, and see "Official Notices" June 10th.

Belgium.—August 1st. The municipal authorities of Stavelot are inviting tenders until August 1st for the concession for the supply of electrical engines for lighting and power purposes in the town during a period of 30 years. Tenders to be sent to L'Administration Communale de Stavelot (Belgium). Particulars from the Secretariat de la Ville on payment of 4 francs.

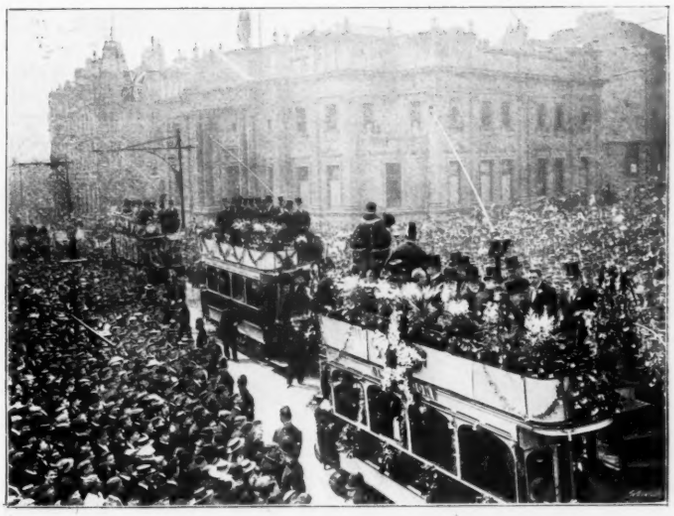
Bethnal Green.—June 28th. The Board of Guardians invite tenders for supplying the necessary plant and installing the electric light at the new infirmary, Palestine Place. For particulars see our "Official Notices" June 10th.

Bootle.—June 28th. The Corporation wants tenders for the erection of an electric light station in Pine Grove. Particulars from the borough engineer, Mr. J. A. Crowther.

(*Continued on page* 889.)

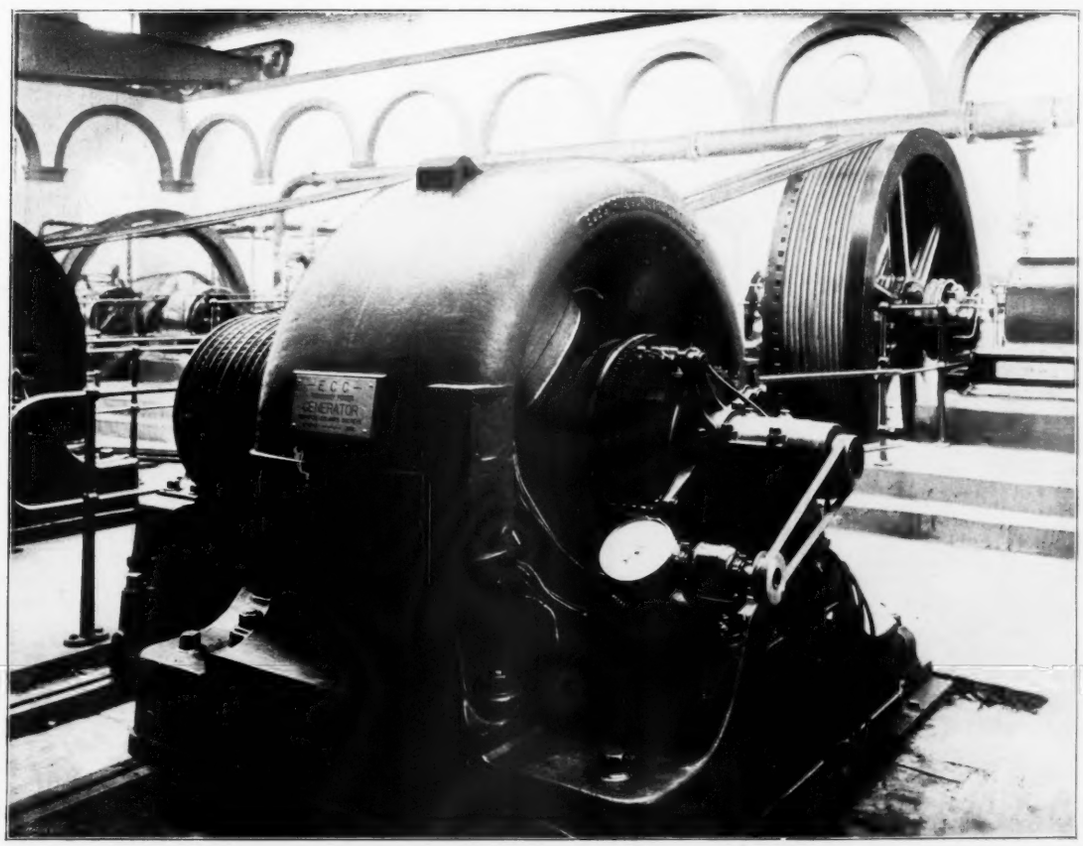
THE HALIFAX MUNICIPAL ELECTRIC TRAMWAYS.

The completion of the Halifax municipal electric tramways is of special importance at the moment, because it constitutes what we may fairly term the first combined lighting and tramway system in the country in which the plant is entirely controlled by a municipality. It is scarcely necessary to say that it is the forerunner of many others, for constructive work on similar lines is being carried out at Glasgow, Hull, Bradford, and Plymouth. The advantages of combined schemes are too well known to be recapitulated here, and though we cannot go so far as to say they are likely to show any startling economy, it is undeniable that some benefit will accrue to the arrangement.



An Imposing Ceremony.

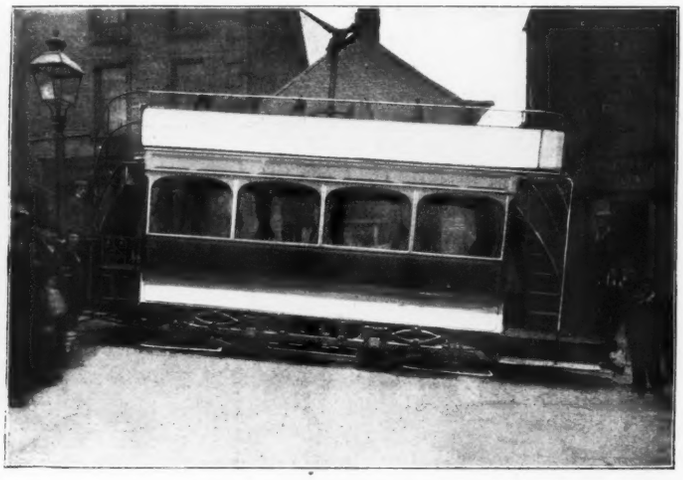
Prior to the introduction into Halifax of the present electric lines, no system of tramways existed in the town, and we are not surprised. "Up the street" and "down the street" are phrases that have some real significance in Halifax. The 'buses that traverse some portions of the town require teams of five horses; even then the tenure of life is so limited, that a horse is not expected to be in active service for more than three years, and it is a frequent occurrence for one to make a quiet protest by dropping dead in the street. Under such conditions a cable tramway would at once suggest itself, but it is doubtful whether such a system would have been flexible enough, especially when taking into consideration the development that was likely to occur. A suggestion was made, we believe, to have a combined scheme of cable and electric line, but piecemeal systems are always best avoided, moreover, in spite of the advantages offered by a cable on severe gradients, we are, after a close examination of the Halifax lines, doubtful whether even a cable system would have given a more satisfactory performance than we witnessed last week. We will, however, again return to this phase of the subject; in the meantime, we would observe that the Parliamentary Bill giving powers to the Halifax Corporation to lay down, equip, and operate electric tramways, was granted last year. When the scheme of electric tramways was entered into by the corporation, it was clearly accepted that it was to be in conjunction with the existing lighting system, and it was estimated that the capital cost on the alteration of the existing buildings and provision of additional plant would be about £8,000. It



View of Tramway Generator.

was also held that the cost of providing separate plant and buildings would in all probability amount to £40,000, and there would be a proportionate increase in the cost of working.

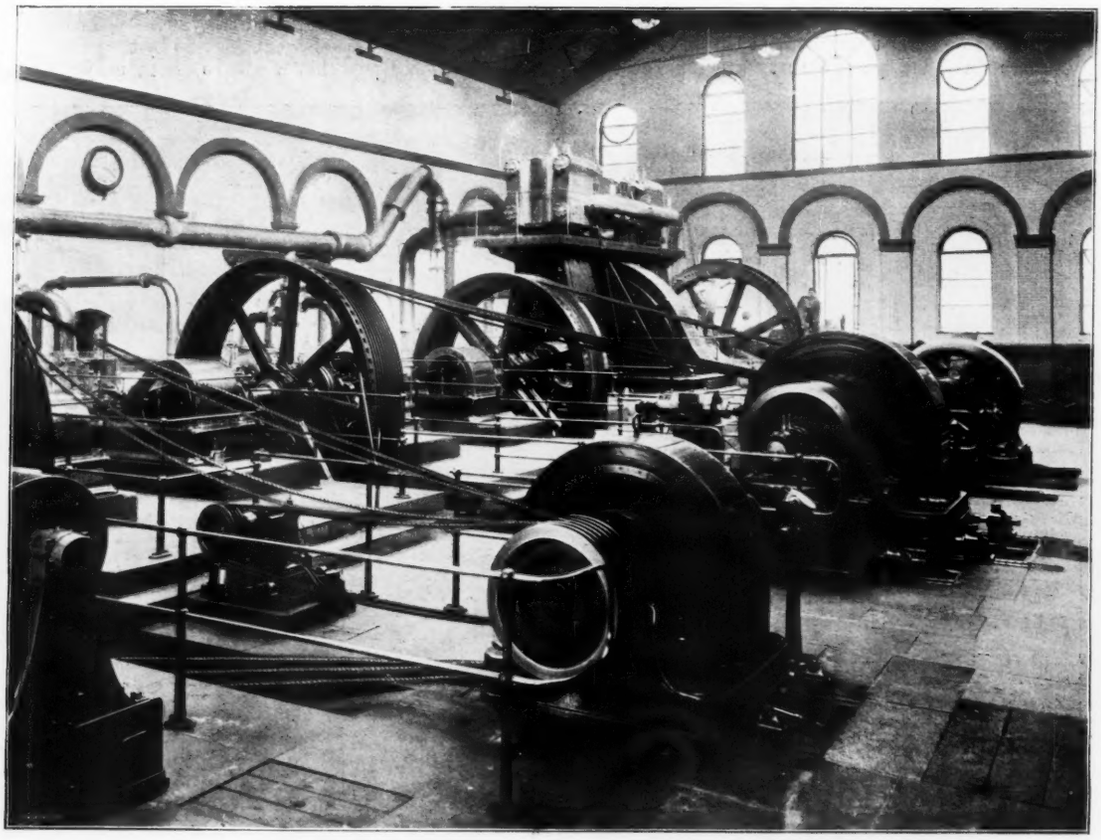
When we described the Halifax Municipal Electricity Works some three years ago,* the principal features noted were that the system was a high pressure alternating one, with substation and house transformers. The plant consisted of three Lancashire boilers, fitted with mechanical stokers, while the generating machinery consisted of three horizontal compound condensing engines, driving alternators by ropes. Two sets were of 100 kw. each, the third of 50 kw., and though the aggregate kw. capacity was not excessive, it proved sufficient to meet the requirements of Halifax for some time. Since our description appeared there has been some considerable extensions to the plant, chief of which is a fly-wheel alternator of 350 kw. This is driven by a compound vertical condensing engine of 600 I.H.P., fitted with Corliss valves. The dimensions of the cylinders are 18 inches × 35 inches × 3 feet, and the speed is 130 revolutions per minute. The alternator is of the fixed iron cored armature type, the revolving field magnets consisting of one winding with the poles staggered. A similar set is in process of construction, the only difference being in the dimensions of the cylinders.



Car descending Gibbet Street.

The original design of the Halifax municipal system paid great regard to the future expansion of electric lighting, and we need hardly point out that where engineers consider future developments, and arrange their buildings accordingly, the profit earning stage is not reached so early as in those systems which merely regard the demand of the moment. The lighting system has not shown a profit, though one would have been made last year if further reductions in the price of electricity had not been made.

In considering the tramway side of the undertaking in more detail, it will be convenient if we refer at this stage to the generating plant. It would be following precedent to refer to the steam-raising plant first, but in this case no additional boilers have been necessary, the spare boiler which had been provided to meet the development of the lighting having been utilised. As we have already remarked, Mr. Wilmshurst, in laying down the original plant, took some



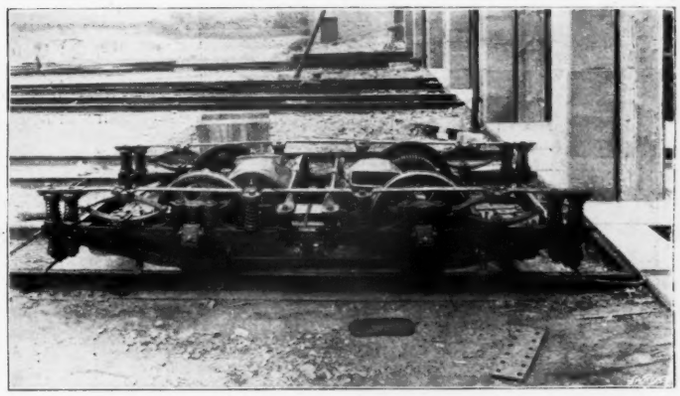
General View of Generating Station.

* February 1st, 1895.

heed for the morrow, and the addition of the tramway plant has not necessitated the extension of the buildings by a single yard, even the present considerable increase to the lighting machinery being accommodated in the original building.

Upon entering the electricity works it is not easy, at first, to differentiate the tramway plant from that devoted to lighting, because, as will be seen by referring to the general view, the tramway generator and its engine are placed about the centre of the room, and is somewhat over-shadowed by the lighting plant that has been added during the past year.

A solidly built generator, made by the Electric Construction Corporation, driven by ropes is the chief feature, indeed, at the moment, the only one of the tramway plant. The generator is of the four-pole type, having an output of 220 amperes at 500—550 volts. The engine which drives this plant was formerly employed in driving one of the lighting alternators. It does not differ very materially from the other horizontal steam motors used in these works, the only alteration being the substitution of a heavier fly-wheel than was formerly used, the increase in weight being about 100 per cent. In one corner of the building foundations are being made for a motor alternator, which will act as a kind of intermediary between the lighting and the traction systems.

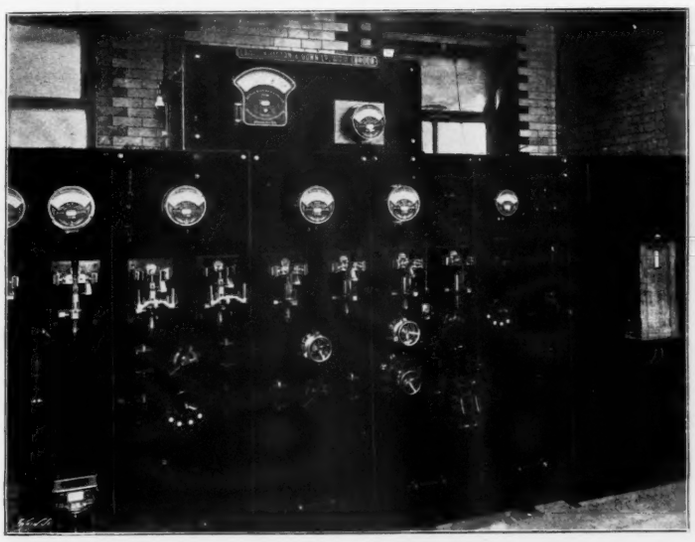


View of Truck.

This plant will consist of a continuous current machine, which will be connected by ropes to an alternating current motor. By driving this set from the alternating current circuits, the continuous current machine will be able to supply energy to the tramway circuits; but Mr. Wilmshurst is relying on this plant to be more useful than that. A battery of accumulators has been provided, and it is proposed to obtain a supply of electricity from this to drive the continuous current machine as a motor, and thus reverse the alternator for the purpose of supplying the lighting load at the time of minimum demand. This is the first instance in this country where accumulators have been used indirectly to supply electricity for alternating current circuits. Primarily, of course, the battery of accumulators has been laid down for the benefit of the tramway plant; but in Mr. Wilmshurst's programme it is destined to fill a good many parts.

Practically it will fulfil three functions; firstly, it will act as a fly-wheel to the whole system; secondly, it will run the whole of the tramway service during the peak of the lighting load, and it will run the early morning cars; and, thirdly, by reversing the motor alternator, it will run the alternating lights during the hours of light load. Another important advantage of the battery from the lighting point of view, is that it will be possible, in all probability, to shut the station down at night, which will be a novel experience in an alternating system. This arrangement gives some indication of the way in which the combination of a tramway and lighting system materially helps the lighting side of the undertaking. The battery is made up of 270 cells of the well-known Chloride type. Each cell is made up of 63 plates placed in lead boxes, and the whole battery will discharge 150 amperes for 9 hours, 200 amperes for 6 hours, and 300 amperes for 3 hours. A motor-driven booster, which adds 150 volts to the traction bus bars, is provided for charging the battery.

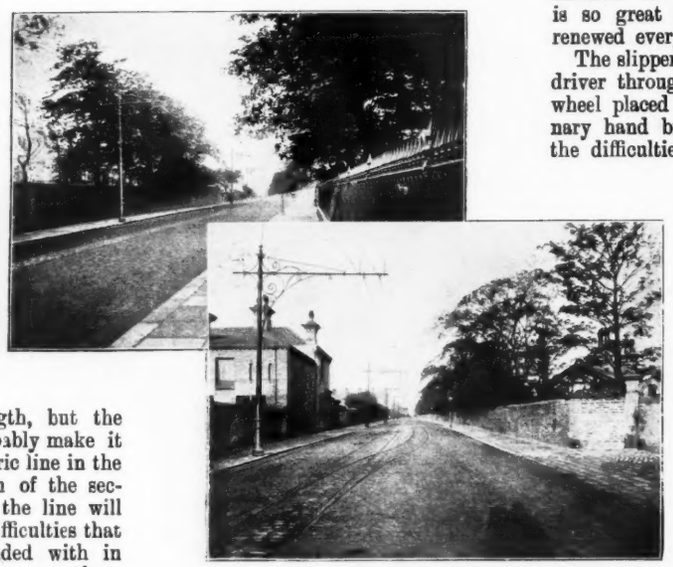
The tramway switchboard is placed in a separate room, much after the manner of the lighting board. It will be seen from the illustration that as regards arrangement it does not differ greatly from other tramway boards. It is built up of a series of black marble panels fixed on an iron frame. It is essentially fireproof, and being built some distance from the wall, permits of easy access to the back. There are six panels:—(1) Feeder, (2) generator, (3) motor-alternator, (4) battery and booster, (5) Board of Trade, (6) voltmeters. An ammeter is provided on each board, and the feeders and generator panels are furnished with automatic cut-outs. The connections of the board are clearly shown in the diagram, but it may be observed that the instruments for testing the fall of potential in the rail are placed in a substation in the town. An Aron meter on the battery board indicates the charge and discharge of the battery.



Switchboard.

The circuit breaker is of the Cutter type, and as we have not previously described it in these columns, the following description, taken from "Modern Switchboards," by Albert B. Herrick, may be interesting. The illustration shows the construction of this circuit breaker in side view, and in part section. "The main current circulates around the solenoidal coil, B, and tends to draw into the solenoid the movable plunger, C. The initial position of this plunger in the solenoid is determined by the adjusting screw, M. When the current is sufficient to overcome the weight of the plunger, it is drawn into the coil with constantly increasing velocity, due to intensified magnetic action, as the polar distance or air space is decreased. When nearing the upward limit of its travel, having acquired a high momentum, it impinges upon the trigger, N, through the medium of the

push-pin, E. The immediate result of this is the release of the switch-arm by the displacement of the retaining catch, F. The upper projection, H, of the trigger, N, is thrust against the striker plate, K, thereby utilising the energy of the current to start the movement of the switch arm. This movement is intensified and sustained beyond the point of final rupture between the switch contacts by the thrust of the spring, O, which is released from compression by the initial action of the trigger. Thus the contact arm is thrown away from the contact terminal and the circuit is opened." Auxiliary carbon contacts are provided, which preserve the metallic contacts from the deleterious effects of an arc.



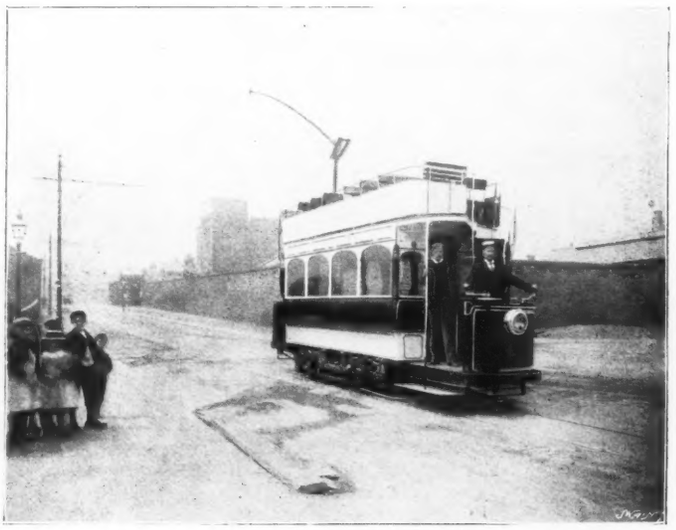
Street Views.

The Outside Work.

The line at the present moment is not a long one, and is under four miles in length, but the gradients and curves probably make it the most remarkable electric line in the country. A consideration of the sections of two portions of the line will demonstrate the natural difficulties that have had to be contended with in Halifax. We do not suppose there is a greater length of level track than 100 yards in the whole system, and in addition to the excessive gradients there are many sharp curves, one or two having a radius of only 30 feet. The section of line which traverses Gibbet Street and High Road Well is most remarkable; it is 1½ miles in length, and from one end to the other there is a rise of over 375 feet, which practically gives an average gradient of 1 in 20. We give an illustration of the car standing at a point on the descent, but it does not altogether demonstrate the severity of the gradient. Though the present lines are steep enough, we believe the extensions, for which Parliamentary sanction has been partially obtained, include gradients of 1 in 10, which is almost equivalent to mountain climbing. We believe that an off hand opinion, based on a perfunctory survey of the town, would have declared against an electric tramway system and it is not surprising to find that cable tramway men considered electricity to be impossible. The results have completely falsified these views, and it is apparent that there are few places which cannot be worked by electrically-propelled cars. It is not surprising to learn that to propel a car up one of the gradients calls for an expenditure of current of nearly 100 amperes, practically equivalent to 65 H.P. used continuously from end to end. This is to some extent counter-balanced by the cars being able, on the return journey, to travel from one end of the line to the other without any current whatever; the cars, as a matter of fact, travelling from end to end of the line on the brakes. The question of brakes in a place like Halifax is naturally a serious one; in addition to the ordinary brake operated by hand, there is a slipper brake and an electric emergency brake provided on the cars. The slipper brakes are made to rub on the surface and in the groove of the rail, and the wear on the inner surfaces of these, which is of wood, is so great that they require to be renewed every day.

The slipper brake is operated by the driver through the agency of a hand wheel placed directly under the ordinary hand brake. It is obvious that the difficulties of the road call for the exercise of considerable skill in the operation of the cars, and the Halifax Corporation have engaged three or four skilled motorneers, who will drive the first series of cars and instruct new drivers.

Although the expenditure of energy to drive the car is occasionally heavy, it is quite likely that the consumption of current will not exceed one unit per car mile, owing to the cars travelling considerable distances without consumption of electric energy.



View of Car on Line.

The gauge of the track is 3 feet 6 inches, the rails, which are of the girder section, weighing 98 lbs. per yard. The dimensions will be seen in the sectional drawing. The Columbia rail bond is used throughout, and is No. 0000 gauge ·46 inch. There are two bonds to each rail, cross bonds being used every 90 feet.

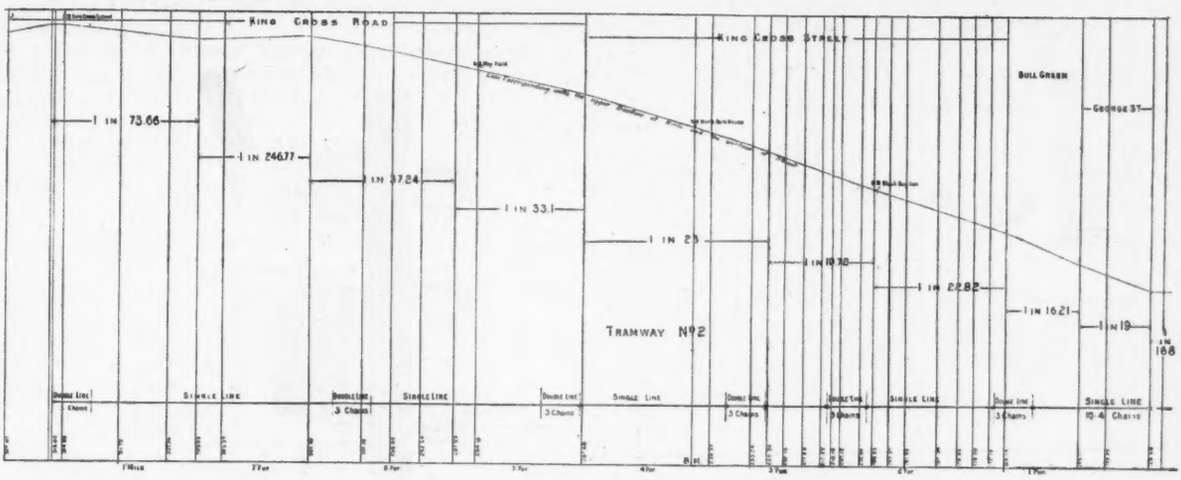
The principal features of this bond, which have been already alluded to in these columns,* consist of the ends or heads of the bond being placed in a thimble, which is placed in a hole in the rail. The contact of the rail and bond is made by a wedge expanding the thimble against the hole in the rail, as will be seen from the sectional drawing. The holes in the rails were drilled after the rails were laid, thus ensuring contacts being clean; the bonds were afterwards coated with tar.

Although the line is for the most part only single track, two trolley wires are used nearly throughout the system, thus avoiding frogs. They are of 0 gauge, ·324 inch diameter, and are carried on side poles in the manner shown in the illustrations. The poles, which are of the steel tubular type, made by Messrs. Spencer & Sons, are placed 40 yards apart

* September 24th, 1897.

at the edge of the kerb, the arms supporting the trolley wire varying from 5 to 15 feet in length. In the centre of the town arc lamps of the alternating current type are suspended from the arms; the transformers for these are placed in the base of the steel posts, and the arrangement has proved so satisfactory, that an addition of 30 to the already existing 40 will be made before the winter. Owing to the large glow lamps. Outside seats are provided, the trolley of the Dickinson type being carried on a pillar some feet above the roof of the car. There is seating accommodation for 20 inside and 24 outside, the weight of each car complete being about 7 tons.

The car shed, which has been erected at the end of the Gibbet Street section, will accommodate 18 cars. It is



SECTION OF ONE ROUTE.

number of telephone and telegraph wires erected overhead, quite an elaborate system of guard wires has been rendered necessary, but with the eventual disappearance of the overheard telephone wires the necessity will soon cease. The guard wires are of galvanised iron, No. 7½, and are fixed about 2 feet above the trolley wire; they are efficiently earthed at different points. In accordance with what is now common practice, the overhead wire is arranged in half-mile sections, the boxes at these points containing four switch fuses and two Garton lightning arresters.

Two armoured feeders run from the works to a sub-station in the centre of town, and from here three cables radiate to Ward's End, King Cross, and Gibbet Street. A telephone and pilot wire cable, consisting of three 7/20 cables, is laid along side each feeder. All these cables are vulcanised bitumen. The feeders have ·15 square inch sectional area, and the return feeder (section ·33 square inch) being drawn in Doulton casing, and spare ways are left for extensions.

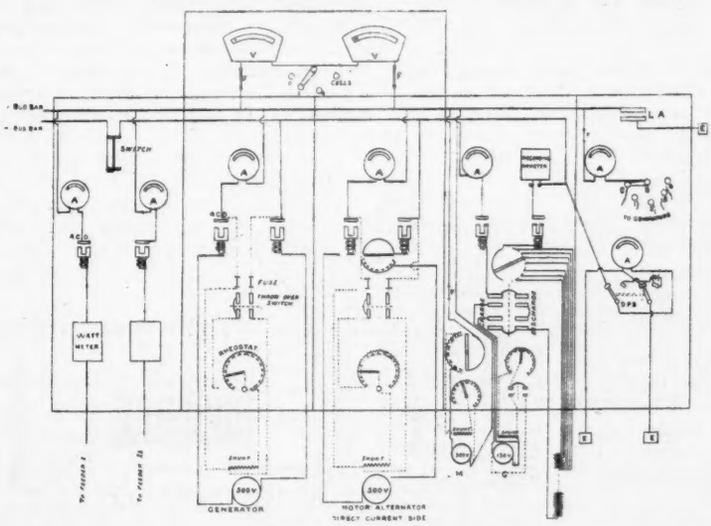


DIAGRAM OF SWITCHBOARD.

At the sub-station, which is an extension of a transformer lighting station, where the feeders are brought, feeder switches are arranged by which the various sections of the line can be controlled. At this point are also fixed the Board of Trade measuring instruments.

There are 10 motor cars at present, the trucks being of the Peckham type, having a wheel base of 5 feet 6 inches. The bodies are very similar to those employed on the Leeds lines, and are excellently designed and finished; they have been made by Messrs. Milnes & Son.

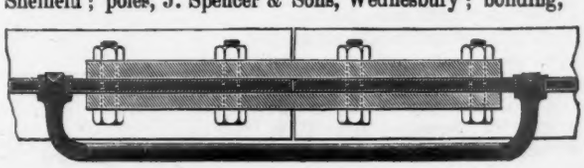
Each car is fitted with two motors of the E C.C. enclosed type, B.T.H. controllers of the K type, and are lighted by 10

provided with inspection pits and equipped with a 6-ton travelling crane. Alongside are arranged repair shops, mess room, manager's office, &c.

It may be interesting to mention that the service of cars commences at 5.30 a.m., there being half-hourly cars till 8 a.m., when a 10-minutes' service is continued throughout the day. The two routes overlapping in the centre of the town constitute a five-minutes' service from there to the station. The speed in the town is limited to 7 miles an hour, and there are fixed stopping places.

The tramways are controlled by a specially constituted Tramways Committee, which purchase current from the Lighting Committee at 2d. per unit. The Lighting Committee furnish the plant, the feeders, and the necessary feeding switches and so forth, but the rest of the equipment, including the overhead wire, is supplied by the Tramways Committee.

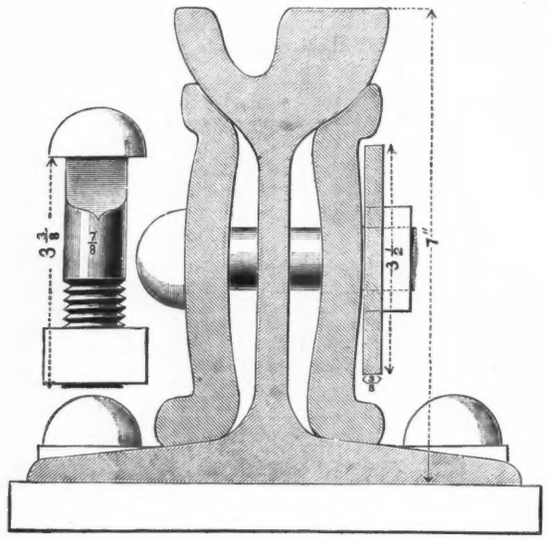
The following is a list of the principal contracts and contractors:—Car shed, J. Charnock and Sons, Halifax; rails, The Leeds Steel Works; points, Askham Brothers & Wilson, Sheffield; poles, J. Spencer & Sons, Wednesbury; bonding,



overhead equipment, car-trucks, motors, trolleys, generators, &c., The Electric Construction Company, Wolverhampton; car bodies, G. F. Milnes and Co., Birkenhead; accumulators,

The Chloride Electric Storage Syndicate, Clifton Junction; switchboard, Laing, Wharton & Down.

The work has been superintended by the borough engineer,



Section of Rail and Fish Plate, and Detail of Bolt and Nut.

Mr. E. R. S. Escott, the borough electrical engineer, Mr T. P. Wilmshurst, the traffic manager, Mr. Fred Spencer, while Mr. N. H. White has represented the Electric Construction Company.

We are especially indebted to Mr. T. P. Wilmshurst for the aid that he has given us in compiling the foregoing account of what is a most interesting system.

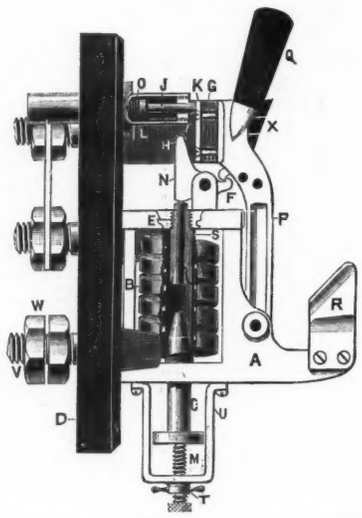
ELECTRICAL CABS IN PARIS.

Though originally the spirit motor, useful enough for country work, made a fairly brave show in Paris, the electric cab seems, as in London, to be coming to the front, as it certainly ought to do in a city of asphalte paving. The cab trials of the Automobile Club just completed included only one vehicle of the petroleum order, all the rest being electrical. In fact, the Paris cab companies have made numerous experiments, which have caused them to throw over the petroleum cab and adopt electricity.

The Krieger cab, as illustrated in the *Engineer*, much resembles the electrical cabs in London. The Jeanteaud cab is after the fashion of the well known fiacre, while the cab of the Compagnié Générale des Transports was placed on a very long wheel base, and weighed 1,662 kilos by reason of possessing rapid charging accumulators, put in under a mistaken idea as to conditions to be met.

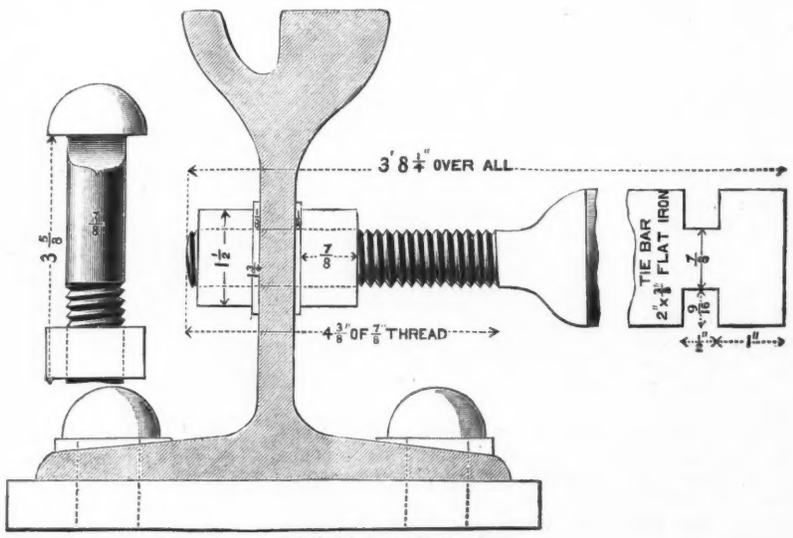
Preliminary tests were first made on the maximum speeds each cab could attain, their brake power, reversal facilities, and hill climbing capability. These were made on the gradients of Suresnes and Mont Valerian and along the Seine banks, and were carried out by M. Forestier, of Les Ponts et Chaussées. Then followed three routes of 37 miles (60 kilometres) each, of various description of road, good and bad. The average speed attained was 13 to 15 kilometres.

In the Krieger cab 866 of the total 1,360 kilos are upon the front wheels, and the cab carried three passengers and 70 kilos of baggage. Its Fulmen accumulators required seven to eight hours to charge. The front axle carries two motors geared to a toothed wheel bolted to the front wheels, which both drive and steer. The cab varied its expenditure of energy from 24 amperes at 92 volts at a speed of 18 kilom. per hour



Halifax.—Section of Cutter Automatic Circuit Breaker.

along the Champs Elysées and Avenue de l'Alma. It then mounted the macadam of the up grade Rue de Magdebourg at 6 kilowatts per hour, discharging 56 amperes at 85 volts, or, say, 3 H.P., next passing over bad and soft macadam at 15, 20, and 26 amperes, and finally down the Champs Elysées, registering 8 amperes, the motors now partially recuperating the accumulators. The effect of road surface was very marked. Level wood required 20 amperes, macadam 26, dry asphalte, at a lower speed, 15. Up hill at low speed, on greasy granite, 36, and again on asphalte 18, 16, and 22 amperes, according to speed.



Detail of tie bar and bolt and nut.
Halifax.—Section of Rail.

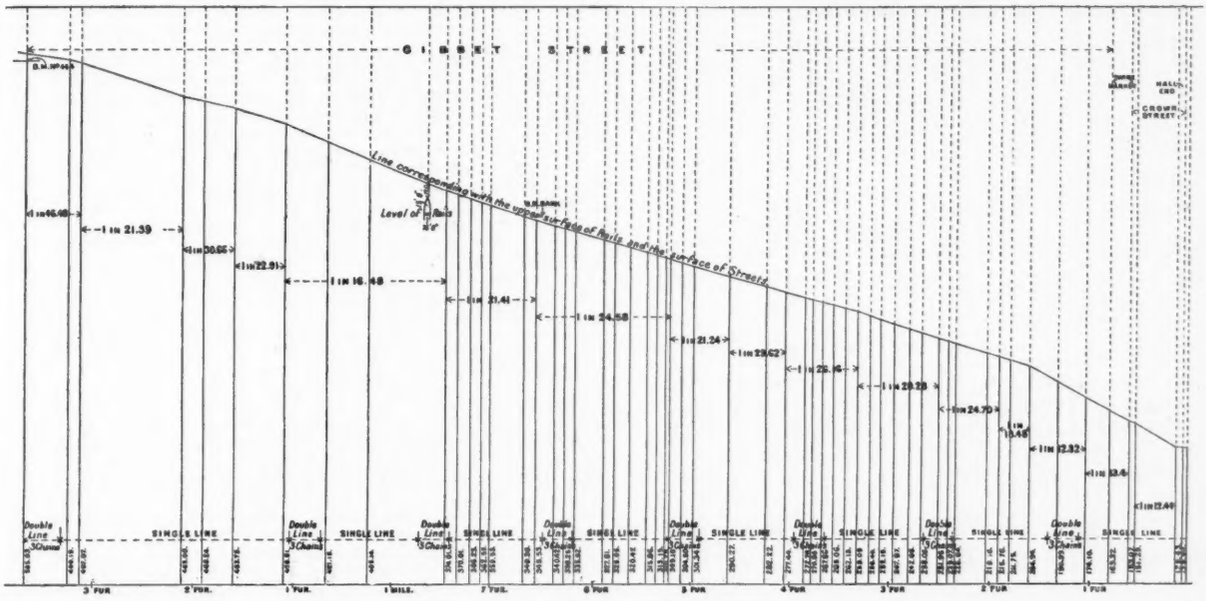
The total energy over the 60 kilom. was 8 kilowatts, but the time is not given. The cab of the Compagnie Générale, which required at 6 kilom. per hour up the heavy grade of the Rue Reynouard, 80 amperes × 85 volts, or fully 9 H.P., consumed 11·7 kilowatts.

The Jeanteaud cab—two passengers—carried its accumulators, of Fulmen type, in front, and a simple motor geared to the rear axle. It expended at the rate of 7½ H.P. on the Rue de Magdebourg, but on the whole course of 60 kilometres about 8·5 kilowatts in 4½ hours, an average of about 2½ H.P. for a very respectable speed. The Peugeot cab—with a two-cylinder motor—is well spoken of by the *Engineer*, and is faster than the electric cabs, and there is no vibration when running, though this is bad when standing—our own experience also.

It consumed 13 litres of petroleum spirit in running 60 kilometres, or say, fully 2¾ gallons, and it used at the same time 1¾ gallons of cooling water.

This corresponds with, say, 0·6 of a lb. of fuel per mile. Thus, such a vehicle would run from London to St. Albans and back, with about 24 lbs. of fuel, or, say, 3 gallons.

The trials all point to the conclusion to which previous experience points, that for city work the electrical cab is coming to the front, and for country roads, less suitable for accumulators and less convenient as regards re-charging, the spirit motor will find its chief field, leaving the heavy work probably to steam. We would not at present advise the trial of electricity beyond narrow limits.



HALIFAX.—SECTION OF ANOTHER ROUTE.

CONTRACTS OPEN AND CLOSED.

(*Continued from page* 882.)

Bulgaria.—June 27th. Some little time ago the municipal authorities of Sophia, Bulgaria, invited tenders for the concession for the electric lighting of the public streets of the city, and for the construction and working of an electric tramway. The authorities are again inviting tenders, until the 27th inst., for this concession, particulars of which may be obtained from above.

Cardiff.—June 28th. The Corporation wants tenders for two water-tube boilers for the electricity works. Particulars from the borough electrical engineer, Mr. Appelbee; also see our "Official Notices" June 17th.

East London (Cape Colony).—June 28th. The Town Council is inviting tenders for erection of buildings and the supply of electric lighting machinery, electric tramcars, plant, rails, &c., and for their maintenance for six months from completion. Particulars from Messrs. Dyer & Dyer, 17, Aldermanbury, London, E.C., on payment of £5, repayable on the receipt of a *bond fide* tender.

Edinburgh.—June 30th. The Corporation wants tenders for the supply of copper strip for electric conductors. Particulars from the resident electrical engineer, and see our "Official Notices" June 17th.

France.—June 30th. Tenders are being invited by the municipal authorities of St. Laurent de la Salanque, a small town of about 4,500 inhabitants in the Pyrenées Orientales, for the concession for the electric lighting of the public streets. Full particulars may be obtained from, and tenders to be sent to, Le Maire, de St. Laurent de la Salanque, Pyrenées Orientales, France.

France.—July 7th. Tenders are being invited by the French Post and Telegraph authorities in Paris for the supply of 760 metrical tons of galvanised iron wire, and 617,000 porcelain insulators. Particulars may be obtained from, and tenders to be sent to, Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Hammersmith.—July 4th. The Vestry wants tenders for the supply of eight 25-kw. transformers. Particulars from the Vestry Clerk (Mr. W. P. Cockburn), Town Hall; also see our "Official Notices."

Heckmondwike.—June 30th. The directors of the Heckmondwike Industrial Co-operative Wholesale Society want tenders for an electric light installation (about 500 lights) including generating plant for their premises. Consulting electrical engineer, Mr. Walter Leake, 51, Victoria Buildings, Manchester. See our "Official Notices" June 17th.

Hull.—July 1st. The Corporation wants tenders for wiring and the supply of fittings for the East Hull Baths. Particulars from the city engineer (Mr. A. E. White). See our "Official Notices" June 17th.

Leeds.—June 29th. The Council requires tenders for two engines and dynamos of about 1,000 H.P. each; also for 50 electric tramcars. Particulars from Dr. John Hopkinson; also see our "Official Notices" June 17th.

Melbourne.—August 16th. The City Council is inviting tenders for the supply and delivery of arc lamp carbons. See our "Official Notices."

Newington.—July 1st. The Vestry of St. Mary invites tenders for the construction, supply, and erection of boilers, pumps, steam and water mains, water tank, surface condenser, fuel economiser, &c., for the electricity works in Penrose Street, Walworth. Consulting engineers, Messrs. Kincaid, Waller & Manville. See our "Official Notices" June 17th.

Shanghai.—August 10th. The Shanghai Municipal Council invites tenders for the supply of two 100-kw. direct coupled steam alternators, switchboard, and water-tube boiler. Particulars and specifications to be obtained from Messrs. John Pook & Co., 8, Jeffreys Square, St. Mary Axe, E.C., to whom tenders have to be sent. See our "Official Notices" this week.

St. Pancras.—July 12th. The Vestry wants tenders for condensing plant, steam pipes, &c., for the Regent's Park generating station, 47, Stanhope Street, N.W. Particulars from the chief clerk, Electricity Department offices, 57, Pratt Street, N.W. See our "Official Notices" this week.

Tunbridge Wells.—June 27th. The Corporation wants tenders for the electric wiring of the new baths in Monson Road. Particulars and specifications at the Borough Surveyor's Office.

Victoria.—June 24th. The Council of the city of Hawthorne (Colony of Victoria, Australia) is inviting tenders for the supply and erection of buildings, boilers, engines, dynamos, transformers, mains, meters, arc lamps, poles; also running the plant for three years. See our "Official Notices" March 11th.

Wimbledon.—June 27th. The District Council wants tenders for the installation of the electric light mains and fittings in the new depôt buildings in Queen's Road, Wimbledon. Particulars from the Council's engineer, Mr. C. H. Cooper. See our "Official Notices" June 17th.

York.—June 24th. The Corporation is inviting tenders for the erection of an electric light station. Particulars from the City engineer, Guildhall.

CLOSED.

Ayr.—The Police Commissioners have given the contract for the new electric light posts to Messrs. Macfarlane, Glasgow.

Bristol.—The City Council has given an order to Messrs. D. Parsons for electric lamp posts (£1,467) for street lighting; and to Messrs. Willans & Robinson for an additional engine at £2,255.

London.—The London County Council on Tuesday referred to committee for consideration, and report the following tenders opened for the supply of engines and dynamos for the electric lighting of the Crossness outfall works:—

J. Fowler & Co., Leeds (for two dynamos and accessories only)	£860
W. R. Renshaw & Co., Stoke	4,497
Calvert & Co., Manchester	4,600
Scott, Anderson & Beit, Sheffield	4,750
Safety Concentric Wiring Company	4,990
Laing, Wharton & Down	5,455
Edmundson's Electricity Corporation	5,580

The following tenders for cables and wiring for the same installation were similarly referred to committee:—

Fowler, Lancaster & Co.	£2,560
National Electric Free Wiring Company	2 680
J. H. Pickup & Co.	2,712
Scott, Anderson & Beit	2,7?0
Calvert & Co.	2,800
British Insulated Wire Company	2,893
Allingham & Fennell	2,943
H. T. Rogers	2,950
Safety Concentric Wiring Company	3,250
Laing, Wharton & Down	3,484
A. H. Wood	4,880
J. Jenkins & Sons	5,050
T. H. Taylor	5,800
G. Stegman	6,225
Sax, Slatter & Co	6,500
Walsall Electrical Company	6,912

Yarmouth.—The Council has given Messrs. Gray and Palmer the contract for electric light wiring and fitting at the Isolation Hospital, at £73 odd.

FORTHCOMING EVENT.

1898.

Friday, June 24th at 5 p.m.—Physical Society. Agenda:—1. Exhibition of an Apparatus illustrating the action of two coupled Electric Motors, by Prof. Carus-Wilson; 2. Exhibition of Weedon's Expansion of Solids Apparatus, by Mr. J. Quick; 3. "On the Theory of the Hall Effect in a Binary Electrolyte." By F. G. Donnan, M.A., Ph. D.

NOTES.

New Cable.—The cable ship, *Faraday*, left the works of Messrs. Siemens Bros. & Co., Woolwich, on Wednesday afternoon with some 670 miles of submarine cable on board for the West Indies, to the order of the West India and Panama Telegraph Company. The manufacture and testing have been supervised by Sir Samuel Canning and Mr. T. E. Gatehouse, and the cable is certainly one of the best ever made, and reflects every credit upon the contractors. Mr. Graham, of Messrs. Siemens's staff, accompanies the expedition as electrician-in-charge.

Personal.—We understand that Mr. Walter Riggs, A.I.E.E., has resigned his position as outdoor manager to the Liverpool branch of the Westminster Engineering Company, Limited, of 27—31, Regency Street, Westminster, to take up an appointment on the Peninsular and Oriental Steamship Company.

Local Authorities and Electric Lighting.—The Bill to confirm the electric lighting provisional orders which have been granted by the Board of Trade to the Vestries of Bermondsey and St. Marylebone having been referred to a Select Committee, objection has been taken, on behalf of the vestries, says the *Times*, to the right of the companies to appear before the Committee in opposition to the orders being confirmed. The question of the *locus standi* of the companies will therefore have to be decided by the Court of Referees. The companies who have lodged petitions against this Bill, and whose *locus standi* is now called in question, are the London Electric Supply Corporation, the Metropolitan Electric Supply Company, the County of London and Brush Provincial Electric Lighting Company, the Chelsea Electric Supply Company, and the St. James's and Pall Mall Electric Light Company.

The following letter on this subject has appeared in some of the London papers, from the pen of Mr. J. B. Braithwaite, jun., whose interest in electrical companies is well known:—

27, Austin Friars, E.C., *June 18th*.

Sir,—The importance to investors in electric lighting undertakings of the questions raised by the Bill now before Parliament under which the Vestries of Marylebone and Bermondsey are seeking to obtain powers to compete with existing electricity supply companies within their area, and the fact that my firm has acted as brokers to many important electric lighting issues, must be my apology for addressing you upon this subject.

Something like £5,500,000 nominal capital is now invested in electricity supply companies in the metropolis, on the security of provisional orders granted by the Board of Trade and confirmed by Parliament after the local authority had (*a*) declined to undertake the supply themselves, and (*b*) given their consent to the application for a provisional order by the company.

In most districts two companies are in competition, thus protecting the public against any fear of a monopoly. In all cases the local authority has the right to purchase the companies' undertaking at the expiration of 42 years from 1889, thus securing the reversion of the business to the ratepayers within a reasonable time.

It should be borne in mind, that under the Electric Lighting Act of 1888, the vestries and other local authorities had an equal right with any company to apply for and obtain the grant of provisional orders for the supply of electricity within their areas, and in practice the Board of Trade has always insisted upon the consent of the local authority being obtained to the application of any company for a provisional order.

The local authorities have thus had to face the question of undertaking the supply themselves in preference to allowing a company to do so, and in many cases where they decided to do so, the Board of Trade have given them the provisional order, and refused all applications made by companies. In many cases, however, after full consideration, and obtaining the best expert advice possible, the local authority decided not to undertake the supply itself, but to support the application of a responsible company in preference.

Thus, with the consent of the local authorities in various parts of the metropolis, electricity supply companies are now engaged in supplying the public, and now that the shareholders have risked their capital and through their enterprise the industry has been proved to be a profitable one, it would seem unreasonable that the local authority should be allowed to turn round and reverse its former decision and undertake the supply of electricity itself in competition with the company, whose undertaking it has the right to purchase at the end of a period of years.

Should this practice be allowed, it would be obviously extremely unjust to those who have invested their money in proving the possibility of electricity being supplied at a profit, and would effectually prevent any future companies being formed for any industrial enterprise in which in the event of success they will have to face competition from local authorities using the ratepayers' money against them.

No company can object to fair competition, but when a local authority first encourages a company to incur large expenditure, and then, when the business proves to be profitable, brings in money borrowed on the rates to deprive them of the fruits of their enterprise, it is not competition, but——

If it is desired that power should be given to local authorities to reverse the decision which many of them came to many years ago not to undertake the supply of electricity themselves, it seems only reasonable that, as a condition of the provisional order being now granted to them, they should at least be required to come to some equitable arrangement for the purchase of the company or companies which may already be supplying electricity in their district, and doubtless in Committee a clause embodying this or some other method of effectually safeguarding the interests of the existing supply companies will be introduced.

Apologising for the length of this letter,

I am yours faithfully,

J. B. Braithwaite, Jun.

The Metropolitan Electric Supply Company, Limited has issued a statement of its case against the provisional order promoted by the Vestry of Marylebone seeking powers to enter into competition with it. The memorandum concludes thus:—"Having regard, therefore, to the whole circum-

stances, it is very respectfully but firmly submitted that to give a local authority, without sufficient cause, power to compete with a company efficiently exercising powers granted by Parliament with the consent of that local authority, would be contrary to the intention and policy of Parliament, not only in respect of electric lighting, but also of gas, water, and tramway undertakings, and would, by the shock to public confidence, gravely discourage investment in any enterprise which depended for success on a fair and reasonable interpretation of the intentions of Parliament. It is believed that Parliament has never given powers to any corporation to compete with a company authorised by private Act or provisional order to supply gas, water, or tramway service, and if there is any precedent in the case of electric lighting, it has been created by the Board of Trade without the attention of Parliament having been directed to the question, in consequence of the confirming Bill not having been opposed."

Obituary.—The death is announced of Mr. John Henry Beckwith, M.I.M.E, who had been for the past 30 years connected with Galloways, Limited, engineers, Manchester. For the greater portion of this period he acted as works manager, and for the past 10 years, as a director of the company. He took great personal interest in the various International Exhibitions with which Messrs. Galloways' name has been closely identified, and designed many installations of engines, &c., for rolling mills, hydraulic installations, and other purposes.

We regret to hear of the death, which occurred on 14th inst., of Mr. William Rickard, the founder and sole proprietor of the Ashbourne Road Mills, Derby, where he had for years past carried on business as a wire manufacturer and coverer, and cable manufacturer. The business will continue to be carried on under the same management as heretofore.

We are sorry to learn of the death of Captain Davies, managing director of the Exchange Telegraph Company, which occurred on Tuesday last, at the age of 73. He had been managing director of the company since its inception in 1872, and, with Sir J. Anderson and Mr. Cyrus Field, was one of its founders. Prior to his connection with the Exchange Telegraph Company, Captain Davies had been in the service of the Pacific Steam Navigation Company and the Peninsular and Oriental Steam Navigation Company.

We read, with regret, in our American exchanges, of the death of Dr. Chas. E. Emery, Ph.D., which took place at Brooklyn on June 1st, heart failure being the cause. Dr. Emery was well known in America as a consulting engineer, and his name will be familiar to our readers in connection with the controversy on steam engines for electric traction. Thirty years ago Dr. Emery had charge of the construction of U.S. war and other vessels. In the eighties the Institution of Civil Engineers, London, awarded him the Telford Prize for a paper read by him. He was a prominent member of the American Society of Mechanical Engineers, and was president in 1896-7 of the New York Electrical Society, as well as a member of the American Institute of Electrical Engineers. He was a non-resident professor of Cornell University. He was also a member of the American Society of Civil Engineers. An exchange says that "he was not only an engineer in theory, but in actual practice, and had several patents for important improvements in machinery." He was connected with the New York Steam Company as consulting engineer at the time of his death.

Glasgow Technical College Scientific Society.—On 11th inst. the members of this society visited the new works of Messrs. Mavor & Coulson, Limited. At a meeting of committee held later the report of Dr. H. Dyer (convener of the teaching staff of the college) on the papers sent in for the society's annual competition, was read. The report stated that the paper on "Multiphase Electrical Machinery," signed "Electra," was a production giving evidence of considerable knowledge of the subject, and was recommended for the award. The author was Mr. A. Stewart, to whom the gold medal will accordingly be presented.

Marriage.—On 13th inst. Mr. Frank Christy, senior partner of the firm of Christy Bros., electrical engineers, of Chelmsford, was married at Leominster to Miss Clara Nellie Geaussent.

The Institution of Electrical Engineers' Conversazione.—There was a large and brilliant company at the Natural History Museum, Cromwell Road, on Thursday, 16th inst., for the Institution Conversazione. The guests were received by the President, Mrs. Swan and the Council. An excellent programme of music was performed by the string band of the Royal Engineers under the conductorship of Mr. J. Sommer. Everything passed off very satisfactorily. Among those present were the following:—

Mr. J. W. Swan, F.R.S., President.

Prof. W. G Adams, F.R.S.
Mr. G. L. Addenbrooke
Mr. H. Alabaster
Mr J. F. Albright
Mr. L. Andrews
Prof. W. E. Ayrton, F.R.S.
Sir B. Baker, K.C.M.G., F.R.S
Mr. Shelford Bidwell, F.R.S.
Sir A. R. Binnie
Mr. M. Blumbach
Mr. S. L. Brunton
Prof. Capper
Prof C. A. Carus-Wilson
His Excellency the Chinese Minister
Mr. Latimer Clark, F.R.S.
Mr. Dugald Clerk
Prof. F. Clowes, F.R.S.
Mr. S. Cowper-Coles
Capt E W. Creak, R.N., F.R.S.
Mr. R. E. Crompton
Sir William Crookes, F.R.S.
Sir A. Durston, K.C.B.
Mr. H. Edmunds
Prof. Egaroff
Mr. S. Evershed
Mr. C. E. Fagan
Mr. W. P. J. Fawcus
General Festing, C.B., F.R.S.
Prof. G. F. FitzGerald, F.R.S.
Sir W H. Flower, K.C.B., F.R.S.
Prof. George Forbes, F.R.S.
Prof G. Carey Foster, F.R.S.
Sir E. Frankland, K.C.B, F.R.S.
Mr. E. Garcke
Dr. W. Garnett
Dr. J. H. Gladstone, F.R.S.
Mr. W. T. Goolden
M. Gyeorguiewsky
Prof. F. L. V. Harcourt, F.R.S.
General Sir R. Harrison, K.C.B. (Inspector-General of Fortifications).
Admiral Lord John Hay
Prof O Henrici, F.R.S.
Dr. E Hopkinson
Prof. W. H. Hudson
Prof. D. E. Hughes, F.R.S.
Mr. Holman Hunt
Lord Kelvin, G.C.V.O., F.R.S.
Prof. A B. W. Kennedy, F.R.S.
Lord Loch, G.C.B.
Sir Philip Magnus
Mr. W. G. McMillan (Secretary
Sir Henry Mance, C.I.E.
Major-General J. Mann, R.E.
Master of the Saddlers' Company
Master of the Salters' Company
Mr. H. S. Maxim
Mr. H. W. Miller
Sir S. Montagu
Mr. W. M. Mordey
Mr. S. Morse
Mr. Kenric B. Murray
Sir Hugh Owen, K.C.B.
Major Flood Page
Sir W. Peace, K.C.M.G.
Dr. W. H. Perkin, F.R.S.
Prof. J. Perry, F.R.S.
Mr. J. Denison Pender
Mr. W. H. Preece, C.B., F.R.S. (President Inst. Civil Engrs.)
Sir A. Ramsay
Dr. W. Ramsay, F.R.S.
Mr. J. S Raworth
The Rev. A. Robertson
Sir E. M. Shaw, K.C.B.
Mr. Dane Sinclair
Prof. R H. Smith
Mr. James Swinburne
Mr. Cameron Swan
Sir D. Tennant
Prof. S. P. Thompson, F.R.S.
Dr. T. E. Thorpe
The Rev. Dr. Wace
Prof. R. M. Walmsley
Mr. F. H. Webb
General C. E. Webber, C.B.
Mr. Henry Wilde, F.R.S. (Honorary Member)
Sir E. L. Williams
Mr. J. Wimshurst, F.R.S.
Mr Edward Woods
Sir H. Trueman Wood
Mr. C. H. Wordingham

Water-Tube Boilers in Ships of War.—Perhaps before these lines are in print an opportunity may have presented itself for testing water-tube boilers in actual war service. We are informed that the Spanish ships *Pelayo* and *Christobal Colon*, the latter an armoured cruiser, have Niclausse type boilers, and these have been spoken of as better than the Belleville type. It is thus extremely probable that information of a practical kind may be forthcoming. We have a very poor opinion of any steam boiler, water-tube or any other kind, if exposed to the shock of a shell exploding within it. We may be wrong, but we think any injury to the boilers of a war vessel would expose such vessel to immediate defeat. Of course, the failure of one boiler, if it does not actually explode, may only result in cutting it out of service, but what of the flood of hot water and more or less escaping steam at a critical moment. Even at best a ship would be merely a floating battery; it could not manœuvre, and if it lost all its steam, it is questionable if it could work its guns. There would be neither water-power, compressed air, nor electricity.

Presentation.—Mr. J. C. A. Ward, of St. Pancras, who has been appointed superintendent of mains under the Glasgow Corporation, was, previous to his departure, presented by the St. Pancras Vestry electricity staff with a handsome gold chain with 1898 sovereign attached, upon which a suitable inscription was made.

The Parliamentary Electrical Energy Committee.—In the *Chorley Guardian* for Saturday last, Lord Balcarres, M.P. for Chorley, who, it will be remembered, was a member of the Select Parliamentary Committee on Electrical Energy (generation and supply), writes some notes regarding the Committee's proceedings. He says:—

I cannot claim that the direct results of our labours have been very satisfactory. The Committee was equally divided in opinion, and on a dozen critical occasions our votes were equal in number—four on each side. The Committee was initiated by the Lords; we sat in their House, and deliberated according to their standing orders. It is strange that in so business-like an assembly as the Upper House, there is no escape from the dilemma of a tie. The chairman has no casting vote, and when a division shows equal numbers, the question is settled in the negative. So our report is a document which few members of the Committee would accept as a solution of the problem; indeed, I question whether it satisfies a single member of the Committee; I certainly would refuse to sign it as an expression of my own opinions. However, our report is not mandatory, and the inquiry has not been useless by any means. In the first place we have collected valuable evidence from expert witnesses; we have shown how prejudicial legislation has been to the development of electrical industries, and how the consumer has been obliged to pay unreasonable prices for his light. In short, we demonstrate the urgent necessity for a careful modification of the 1882 and 1888 Acts. Moreover, this is the first time that Parliament has seriously examined the important progress of recent science. The powers of the Board of Trade are large, but they should be widened. The powers of municipal bodies are also large—so large that private enterprise is discouraged. Some corporations want to get the whole business into their own hands; the London County Council wishes to abrogate the rights of 40 local authorities in the metropolis—some of which have populations of 250,000, and even 350,000. Many technical questions arise, and it would not be of interest for me to refer to them here. One of them, however, has a general bearing upon the position of all local authorities. It is provided that, after a certain period, local authorities may buy up the local companies, or any part of their plant—mains, for instance—situated within their own area. This right was given when lighting was the prime function of electricity. Lighting is a civic, communal obligation, and the local authorities should have this privilege. When absent in the case of private gas companies, the public is protected by the sliding scale. But in a few years time lighting will be a subsidiary matter—sometimes nothing more than a bye-product. Should local authorities retain the option to purchase undertakings which supply energy in bulk for motive purposes to factories, workshops, or railways? The distinction between electricity in bulk and electricity for lighting should be defined; the task is difficult, I admit, because one concern can supply both. But discrimination is not impossible, and unless it be achieved, there will be hopeless irremediable confusion when the time for statutory purchase arrives. The Board of Trade should note that lighting is communal, and that energy for motive power is commercial. In the case of the proposal mentioned above, it will be impossible for all the local authorities interested—150 or more of them—to agree among themselves as to the purchase of a huge undertaking which has mains under every authority, transforming stations under others, and one vast generating engine house in the district of a country authority. One might as well ask a group of local authorities to buy up a railway company or the Manchester Ship Canal. Is it not a fit subject for legislation?

The Blackwall Disaster.—It is the unexpected that happens, and surely in the whole category of accidents, nothing more unforeseen than the terrible calamity with which the launching of the warship *Albion* terminated has ever occurred. The sympathy of everybody in the United Kingdom will be extended to the relatives of the unhappy victims of this act of thoughtlessness—for it appears that no blame can be attributed to anybody but to those who became immersed—and also to Mr. Hills and the staff of the Thames Ironworks in this their hour of trial. Especially will electrical men feel for the young electrician, who, if report is to be credited, was suddenly confronted with the dead bodies of his aged mother and young, recently married, sister, who were brought into the dynamo room where he was in charge, and which, for the time, was turned into a mortuary.

The "Arc Works" Sports.—The annual sports in connection with the Arc Works' club (Messrs. Crompton & Co., Limited) took place on Saturday at Chelmsford, in glorious weather. There were 19 events.

Municipal Corporations Association.—On 14th inst. a meeting of the Municipal Corporations Association was held in London to consider, among other things, the Manchester Carriage and Tramway Company's Bill, the Midland Electric Provisional Order Bill, and the General Power Distributing Company's Bill, all of which propose to supply electrical power in bulk to the local authorities and private consumers. The secretary was instructed to watch the progress of the Bills in Parliament, and should the exigencies of the situation require concerted action, to call a further meeting of the Corporations Association.

Electric Search Lights as Weather Signals.—The *Monthly Weather Review* for February contains a note (reproduced in New York *Science*) on the use of electric search lights for the purpose of disseminating weather forecasts. The search light of the U.S.S. *Maine*, which was at the time nearly completed, was, in February, 1895, loaned by the Navy Department to the Weather Bureau for temporary use in Chicago, in experiments designed to test the efficiency of such a means of distributing warnings of coming important weather changes. The light, which had a lens 30 inches in diameter, and whose candle-power was estimated at about 100,000, was erected on the roof of the Auditorium Building in Chicago, at an elevation of 270 feet above the level of the street. It was used but once, on February 28th, 1895, in giving a warning of a coming cold wave, the light being slowly revolved at the rate of one revolution in five minutes. The night was dark and cloudy, and the signal was seen at a distance of 20 miles. A number of experimental trials were also made, and it was concluded that search lights are not useful for the purpose of disseminating forecasts except under the most favourable circumstances. The compiler of these "Notes" recalls that a number of years ago a similar attempt was made during one summer to flash weather forecasts from the summit of Mount Washington, in New Hampshire (6,279 feet). This was a private enterprise, in the nature of an advertisement, but was fairly successful as far as the distribution of the forecasts was concerned.

The Telephone an Aid in Emergency.—Several dramatic incidents were reported in connection with the flood at Shawneetown, Ill., a few weeks ago, but, says the *Western Electrician*, none possess more interest than the heroic attempts that were made by the telephone company's employés to give the alarm and summon relief. Cypress Junction, which is five miles from the scene of the flood, was the first place to hear the news. The bulletin came by long-distance telephone. It was of dramatic and horrible brevity: "The levee has broken! The water is rushing in from the bend a mile and a half up the river. Already 250 people are drowned in the lower part of town, and——" At this point the operator sending the message ceased speaking, the wires went down, and all efforts to regain connection with Cypress Junction failed. A few particulars were received at Evansville, Ind., some time afterward. Two citizens of Shawneetown who had escaped the flood rowed a skiff to a small town near by, and telephoned the brief facts of the catastrophe. They had but few details to give. An appeal for aid was received by the Mayor of Evansville later in the evening. The message was transmitted by a telephone lineman, who climbed a pole four miles above Shawneetown and made a temporary connection to call for aid. Other towns in Indiana were also notified and a few details were thus gathered. The manager of the telephone exchange at Shawneetown gave Mount Vernon its first definite news of the big inundation at the little city down the Ohio River. His message contained the following statement:—"I am four miles from Shawneetown now. I escaped, and made my way here with a portable telephone. I climbed up a telephone post and made a connection, and that is how you are getting the news." The telephone company's employés proved themselves to be heroes of the occasion. Their energetic and intelligent efforts ensured immediate relief for the sufferers, and demonstrated again in no unmistakeable manner the importance to every community of electrical communication with the outside world. Had it not been for the telephone, neighbouring cities could not have been notified of the dire necessities of the people of Shawneetown, and relief expeditions could not have been summoned as speedily as they were in this case.

Smoke Nuisance.—The Metropolitan Electric Supply Company, Limited, were summoned at Bow Street on Wednesday for not complying with a magisterial order calling upon them to abate a smoke nuisance. It will be remembered that the company was fined for a number of cases on May 18th, but the nuisance was not abated. Counsel on behalf of the St. Giles Board of Works said that there were about 30 other summonses since the last cases were heard. It was shown that the company were using the best coal now in the market, but to prevent smoke with this coal they would be bound to reconstruct their furnaces, which would take 10 or 12 months, and involve enormous expense. After a lengthy hearing, Sir James Vaughan said he was satisfied that the company had done all in their power to mitigate the nuisance, and marked the summonses "No conviction." It was stated that the prosecution was forced on the Vestry by the L.C.C.

A batch of similar summonses against the Charing Cross and Strand Electric Supply Corporation were withdrawn by the St. Martin's Vestry.

A Danger in Using Gas Voltameters.—Users of gas voltameters should bear in mind that gases prepared by electrolysis are reputed to possess great activity. They will know what is meant by the active condition of a gas. In the *Zeitschrift für Elektro-Chemie*, Vol. 4 (14), page 342, F. Winteler discusses this subject, and points out a danger which is certainly associated with the use of gas voltameters. When the oxygen and hydrogen are collected together in one tube, it may happen, when the tube is nearly full of the explosive mixture, that the electrodes project into the gas. If the electrodes possess the power of occluding gases they may cause an error by inducing the slow recombination of the gases, or the recombination may be so rapid as to produce an explosion. In any case, this is due to the occlusion of the gases by the electrodes, and not to any special activity of the gas. Reference is also made to another source of error in voltameters, viz, the solubility of the oxygen in the electrolyte, and its diffusion to the cathode, where it is again reduced.

NEW COMPANIES REGISTERED.

Alliance Electrical Company, Limited (57,770).—Registered June 14th, with capital £1,000 in £1 shares, to carry on the business of electricians, electrical, gas, and mechanical engineers, artificers in metal and wood, slate workers, suppliers of electricity, and electrical apparatus manufacturers. The subscribers (with one share each) are:—J. E. Coles, Llewellyn, West Chislehurst Park, Eltham, engineer; C. S. Northcote, Harefield, South Sydenham Park, electrical engineer; T. Jons, Enderby, King's Norton, Worcester, electrical engineer; W. R. N. Grimley, 3, Marlborough Road, Ealing, W., engineer; W. Nicholson, 10, Barnsbury Grove, N., accountant; H. L. Ashford, 104, Ritherdon Road, Upper Tooting, designer; J. W. H. Humphreys, 177, Beston Road, Hanwell, manager. The number of directors is not to be less than two, nor more than five. The subscribers are to appoint the first. Registered office, 8, Heddon Street, W.

Medical Electro-Thermic Generator Company, Limited (57,773).—Registered June 14th, with capital £5,000 in £1 shares, to acquire the invention of A. E. Greville, for the application of heat electrically produced for medical purposes, and to manufacture, sell, and deal in medical, electrical, and thermal appliances. The subscribers (with one share each) are:—J. S. Jarvis, 2, Staple Inn, W.C., solicitor; H. E. Greville, 2, Staple Inn, W.C., solicitor; G. Hickson, Towcester, Northamptonshire, clerk; H. Stedman, Towcester, physician; H. R. P. Lomas, Buxton Hydro., Buxton, proprietor; J. E. Harburn, Thorncliffe, Buxton, surgeon; T. W. Precious, 1, Norland Gardens, Norland Road, W., clerk. Registered without articles of association. Registered office, 2, Staple Inn, Holborn, W.C.

Stiens & Earle, Limited (57,784).—Registered June 15th, with capital £20,000 in £1 shares, to adopt an agreement with P. Stiens and E. J. V. Earle, and to carry on the business of electricians, electrical, mechanical, and consulting engineers. The subscribers (with one share each) are:—H. Tyler, Old Hall, Thurmaston, Leicester, boot merchant; A. E. Bennett, Bella Vista, Streatham, S.W., electrical engineer; E. Earle, Porchester Lodge, Streatham Common, clerk; H. Le Marchant, Stoneleigh, Clapham Common, merchant; H. R. Mann, 53, Claremont Road, Highgate, clerk; J. Weaver, 5, Applegarth Road, Brook Green, W., manager; H. Pope, Carnbrea, Palace Gates Road, Wood Green, secretary. The number of directors is not to be less than two nor more than seven. The subscribers are to appoint the first. P. Stiens and E. J. V. Earle are to join after allotment; qualification, £100; remuneration as fixed by the company. Registered office, 139, Queen Victoria Street, E.C.

Hiram S. Maxim Electric Lighting and Engineering (Pioneer) Syndicate, Limited (57,800).—Registered June 16th, with capital £10,000 in £1 shares, to acquire a certain invention as applied to electric lighting by H. S. Maxim, and to carry on the business of electricians, mechanical engineers, suppliers of electricity, and electrical apparatus manufacturers. The subscribers are:—J. de Meray, 1, Rutland Gate, S.W., gentleman, 4,000 shares; F. A. English, Addington Place, Surrey, landed proprietor, 4,000 shares; J. T. Thompson, 116, Nevill Road, Stoke Newington, gentleman, one share; M. Devenish, 7, Cavendish Place, W., gentleman, one share; F. Cook, 53, Greyhound Road, Kensal Rise, N.W., clerk, one share; C. F. Gillard, 95, Queen's Road, N.E., gentleman, one share; A. J. Rawlinson, First Avenue Hotel, Holborn, surveyor, one share. The number of directors, and the names of the first, are to be determined by the subscribers; qualification, £100; remuneration as fixed by the company. Registered by Williams & Neville, Winchester House, E.C.

Doe Portable Electric Light and Power Syndicate, Limited (57,803).—Registered June 16th, with capital £40,000 in £1 shares, to adopt an agreement with G. O. Scott, and to acquire, develop, and turn into account any patents relating to the production, treatment, storage, application, distribution, and use of electricity. The subscribers (with one share each) are:—P. Dawson, 5, Nevern Mansions, South Kensington, engineer; J. E. Ward, Broad Street House, E.C., chartered accountant; H. Lomas, 47, Church Road, Wimbledon, engineer: H. H. Broadley, 14, Warwick Street, Pall Mall, late captain; E. R. James, Denstone, Culverden Road, Balham, engineer; W. J. Bailey, 11, Henry Street, Kennington, accountant; W. W. Borman, 39, Victoria Street, S.E., engineer. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first. Qualification, 250 shares; remuneration as fixed by the company. Registered by C. Dickinson, 39, Victoria Street, S.W.

Vice Versa Portable Electric Lamp Syndicate, Limited (57,806).—Registered June 16th, with capital £40,000 in 10,000 preferred and 30,000 deferred shares of £1 each, to acquire British patents Nos. 10,444 and 18,628, of 1897, for "improvements in portable electric batteries" and "improvements in portable electric primary batteries," to adopt an agreement dated June 7th with C. H. Cole, and to develop, turn into account, and deal in such patents. The subscribers (with one share each) are:—F. D. Kinnell, 35, Great St. Helens, E.C., manufacturer; T. F. E. Kinnell, Hotel Victoria, S.W., gentleman; F. J. Marriott, 35, Great St. Helens, E.C., secretary; J. G. Hillam, 30, Moorgate Street, E.C., financial agent; J. J. Beaven, 32, Old Jewry, E.C., engineer; W. R. Reece, 36, Copthall Avenue, E.C., agent; M. R. Field, 36, Copthall Avenue, E.C., agent. The number of directors is not to be less than two nor more than five. The subscribers are to appoint the first. Qualification, £100; remuneration, 10 per cent. on the net profits divisible. Registered by J. A. Bartrum, 9, Old Jewry Chambers, E.C.

CITY NOTES.

The Drop in Shares.

The following table shows the fall in the market quotations of Electric Lighting Companies' ordinary shares since March 9th.

	March 9th.	June 22nd.
Charing Cross	13½—14½	11—12
Chelsea	11½—12	7½—8½
City of London	28—29	25—26
County of London	14⅜—15⅝	12—13
House-to-House	11—12	8—9
Metropolitan	20½—21½	14—15
Notting Hill	20—21	15—16
St. James	18½—19½	15—16
Westminster	17½—18½	14½—15

It is hardly necessary to say that this extraordinary fall is due to the unreasonable scare following on the granting of an electric lighting order to the Marylebone Vestry.

Official Announcements re Companies.

The *London Gazette* for June 17th contains notice by the Registrar of Joint Stock Companies to the effect that the following have been struck off the register and are dissolved:—

Birmingham House-to-House Electricity Company.
Caustic Soda and Chlorine Syndicate.
Electrical Accessories Company.
Electric Light and Power Share Trust.
Exeter Electric Light Company.
Irish House-to-House Electricity Company.
Lancashire and Cheshire House-to-House Electricity Company.
Liverpool House-to-House Electricity Company.
Manchester House-to-House Electricity Company.
Midland House-to-House Electricity Company.
Nightingale Automatic Electrical Machine Company.
Northern House-to-House Electricity Company.
Pacific Telegraph Company.
Railway Electrical Fog Signal Syndicate.
Railway Electric Reading Lamp Company.
South of England House-to-House Electricity Company.
Universal Arc Lamp Syndicate.
Western House-to-House Electricity Company.
Wrexham and District Electric Supply Company.

Notice has been given that the following will be struck off in three months unless cause is shown to the contrary:—

Automatic Electric Sign Company.
Canterbury Electricity Supply Company.
Electric and Automatic Engineering Company.
Electric Guest Call Company.
Electric Light Regulating Syndicate.
Electric Time Distributing and Clock Company.
Electro-Mechanical Photographic Syndicate.
Engineering Review, Limited.
Gloria Electrolytic Incandescent Light Company.
"Harp" Arc Lamp Syndicate.
Knoeferl-Bonn Dental and Electrical Manufacturing Company.
Manchester Suburban Electric Supply, Limited.
Pioneer Syndicate of the Capital and Counties Electricity Supply Company.
Silicon Electric Lamp Syndicate.
Town and Village Electric Light and Power Company.
West Australian Electrical Trunk, Power and Lighting Company.

The Electric and General Investment Company, Limited.

The report of the directors to be submitted to the ninth ordinary general meeting of the shareholders to be held at Winchester House, Old Broad Street, London, E.C., on Tuesday, June 28th, 1898, at 3 p.m., states that the profit and loss account shows a gross profit on the transactions of the year of £31,946 13s. 8d., and after deducting all general charges, and the interim dividend already paid on the ordinary shares, there remains a net balance of £25,719 1s. 10d. available for distribution. The directors recommend that this sum be dealt with as follows:—

Ordinary Shares—			
To the payment of a further dividend at the rate of 30 per cent. per annum for the six months ended May 31st, 1898	£3,000	0	0
To the payment of a bonus of 10 per cent. for the year ended May 31st, 1898	2,000	0	0
These payments, with the interim dividend of 10 per cent. previously paid, will make a total distribution of 35 per cent. for the year upon the capital paid up on the ordinary shares.			
Founders' Shares—			
To the payment of a dividend of £30 per share for the year ended May 31st, 1898	3,000	0	0
To the payment of a bonus of £20 per share for the year ended May 31st, 1898	2,000	0	0
Ordinary Shares Reserve Fund—			
To the payment to the trustees of such fund of...	7,859	10	11
Founders' Shares Reserve Fund—			
To the payment to the trustees of such fund of...	7,859	10	11
	£25,719	1	10

The above-mentioned payments will be subject to the deduction of income-tax.

The trustees for the founders' shares reserve fund propose to distribute to the holders of such shares a sum of £20 per share out of the proceeds of investments sold and dividends received in respect of the fund, making a total distribution of £70 on each founders' share. The directors retiring this year are Mr. George Herring and Mr. B. H. Van Tromp, who, being eligible, offer themselves for re-election. The auditor, Mr. G. T. Rait, also retires, but offers himself for re-election. It is proposed to make the dividends payable on June 28th, 1898.

Greenwood & Batley.

The report of the directors of Greenwood & Batley, Limited, for the year ended March 31st last, to be submitted at the general meeting to be held in London on 25th inst., states that, after providing for the interest on the debentures and for the expenses of management, writing off the sum of £2,500 for depreciation, and making a provision of £500 for doubtful accounts and allowances, the accounts show a net profit of £8,658, to which has to be added the balance brought forward, £1,409, making a balance now available of £10,067. The directors recommend that out of this sum a dividend of 7 per cent. should be paid on the cumulative preference shares, which will absorb £7,023, leaving a balance of £3,039 to be carried forward. An agreement has been entered into under which the company has sold its Russian business to the Russian Engineering Company, Limited, for £19,000, payable half in fully-paid ordinary shares and half in fully-paid 6 per cent. cumulative preference shares of that company. The amount received has been written off capital expenditure. Although under this agreement the goodwill of the Russian business is transferred to the Russian Engineering Company, Limited, it is stipulated that this company shall act as the sole agents of the Russian company for the purchase in England of all materials, machinery, or other articles, and are also to manufacture all such special machinery or parts of machinery as that company may require from England for the next 25 years, and a considerable business has already resulted under these conditions. The directors considered it necessary to join the federated engineering employers in resisting the 48 hours' demand, and this action brought about a strike which practically stopped the producing power of the works for seven months out of the year under review. The works are fully employed at the present time, and the contracts on hand and in negotiation give good reason to hope that the business of the present year will be remunerative. The plant, buildings, and machinery have been maintained in efficient working order and condition, £5,176 having been expended during the year under this head, and charged to revenue. The directors regret the loss of their colleague, Mr. George Greenwood, who had acted as a managing director of the company since its formation, and who died in April last.

Birmingham Electric Supply Company, Limited.

The shareholders of this company met at the Queen's Hotel, Birmingham, on Friday last, Mr. H. Buckley (chairman) presiding, to consider the proposed sale of the undertaking to the Corporation. The proceedings were conducted in private. It was understood that the following resolution, moved from the chair, and seconded by Mr. G. Albright, had been carried with practical unanimity:—"That the provisional agreement produced and read at this meeting providing for the sale of the company's undertaking and assets to the Corporation of Birmingham, at the price and upon the terms therein stated, be approved, and the directors of the company be requested to take all necessary steps to carry such agreement into effect." A further motion was unanimously adopted, moved by Mr. G. H. Kenrick, and seconded by Colonel Wilkinson, granting the directors a sum of £2,000 for their services.

Davey, Paxman & Co., Limited.—The prospectus of this company, inviting applications until yesterday afternoon for £100,000 4 per cent. first mortgage debenture stock at 102 per cent., has been before the public this week. This well-known engineering and boiler-making firm of Colchester has now more orders on hand than at any previous date, and it has become necessary to erect new shops, and to provide additional plant and further working capital, for which £30,000 of the present issue of debenture stock will be appropriated. The assets, exclusive of goodwill and the value of patents and licenses, are put at £175,132. Messrs. Bramwell & Harris, and Wheatley Kirk, Price & Goulty, have made a valuation, and this accompanies the prospectus.

The Electrical Company, Limited.—This company which is the English branch of the Allgemeine Electricitäts Gesellschaft, has had, we understand, a successful year's work. The net profit for the year ending March 31st, 1898, after writing off for depreciation, doubtful debts, and for the whole of the furniture, cost of accumulators, dynamo, wires, &c., was £2,364. The reserve fund has been increased by £750; £490 has been distributed to directors, managers, and as bonuses to employés, and a dividend declared of 10 per cent.

Electric Horse Promotion Syndicate.—The *Star* of 17th inst. says that the directors of the Electric Horse Promotion Syndicate, Limited, "have returned to subscribers for the shares the amounts of their subscriptions. We also learn that the inventor of the electric horse apparatus, Mr. A. H. R. Pulman, through his solicitor, Mr. Sydney C. Peters, of 81, Cannon Street, E.C., has given notice for the rescission of the contract, dated February 7th, 1898, for the sale of the patent rights of the said invention."

Eastern Extension, Australasia and China Telegraph Company.—The directors of the Eastern Extension, Australasia and China Telegraph Company, Limited, have declared an interim dividend for the quarter ended March 31st last of 2s. 6d. per share, free of income-tax, payable on July 15th. The coupon on the company's 5 per cent. Australian Government subsidy debentures, due on July 1st next, will be paid on and after that date at Messrs. Barclay & Co.'s bank.

The Shannon Electric Power Syndicate, Limited.—Sir Henry Grattan-Bellew, Bart., of Mount Bellew, County Galway, has been elected to the directorate of this syndicate, in place of Mr. J. Bannatyne, resigned.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending June 11th, 1898, were £2,835 12s. 4d.; corresponding period, 1897, £2,441 6s. 4d.; increase, £394 6s.

The City and South London Railway Company.—The receipts for the week ending June 19th, 1898, were £974; week ending June 20th, 1897, £1,093; decrease, £119; total receipts for half-year, 1898, £25,532; corresponding period, 1897, £25,308; increase, £224.

The Dover Corporation Electric Tramways.—The receipts for the week ending June 18th, 1898, were £152 6s. 9d.; total receipts to June 18th 1898, £2,851 2s. 6d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for week ending Friday, June 10th, 1898, were £748 2s. 5d.; corresponding week last year, £814 0s. 9d.; decrease, £65 18s. 4d.; passengers carried, 110,308; corresponding week last year, 121,265; aggregate to date, £11,711 12s. 6d; aggregate to date last year, £12,362 6s. 4d.; decrease to date, £650 13s. 10d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company.—The receipts for the week ending June 19th, 1898, amounted to £1,440; corresponding week last year, £1,389; increase, £51.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending June 17th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,992.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, June 15th.	Closing Quotation, June 22nd.	Business done during week ended June 22nd, 1898. Highest.	Lowest.
137,400*l*	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	7 — 8	6½— 7½	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	93 — 96	93 — 96	...	...
923,960*l*	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	64 — 67	64 — 67	65¼	...
3,038,020*l*	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	116 —117	116 —117	117¼	116
3,038,020*l*	Do. do. Deferred...	Stock	...	...	...	16½— 16¾	16½— 16¾	16⅝	16½
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15½— 16	15½— 16	15⅞	15 9/16
75,000*l*	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	112 —116	112 —116	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2¾— 3¼	2¾— 3¼	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	105 —107	105 —107	106	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	6½— 7½	6½— 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	14½— 15½	14½— 15½	15	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000*l*	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	4½ %	103 —106%	103 —106%	...	...
60,710*l*	Direct United States Cable	20	2½ %	2½ %	...	10½— 11	10½— 11	11	10⅝
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101—104	...	...
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6½ %	6½ %	...	17¼— 17¾	17¼— 17¾	17⅝	17⅜
70,000	Do. 6 % Cum. Pref.	10	6	6	...	18½— 19½	18½— 19½	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,302,615*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	123 —127	123 —127	124	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17½— 18	17½— 18	17⅞	17½
25,200*l*	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	100 —104	100 —104	...	...
100,500*l*	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	126 —129	124 —128	...	...
35,100*l*	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
46,500*l*	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000*l*	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	101 —104	101 —104	...	...
200,000*l*	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	105 —108%	104 —107%	104	...
180,227	Globe Telegraph and Trust	10	4⅛ %	4½ %	4½ %	11½— 12	11½— 12	11⅞	11⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16¾— 17¼	16¾— 17¼	17¼	16⅞
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	29 — 30	29½— 30½	29¾	...
160,000*l*	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	100 —103	100 —103	...	...
97,000	Halifax and Bermuda Cable, 4½ % 1st. Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —104	99 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	50 — 53	50 — 53	...	...
100,000*l*	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	108 —111	108 —111	...	...
28,000	Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000 ...	5	4 %	4 %	4 %	2¼— 2⅜	2¼— 2⅜	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	5½ %	6 %	5⅝— 5⅞	5½— 5¾	5¾	5½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	16	15
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5½	5 7/16
1,329,471*l*	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	101—106	101—106	104¼	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	1/16	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	8 — 9	8 — 9	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	...
58,000	United River Plate Telephone	5	4 %	5 %	...	4 — 4½	4 — 4½	...	...
146,733*l*	Do. do. 5 % Debs.	Stock	5 %	...	...	104 —107	104 —107	...	...
15,609	West African Telegraph, 7,501 to 23,109	10	4 %	*nil*	*nil*	3½— 4½	3½— 4½	...	...
213,400*l*	Do. do. 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½ %	11⅜— 12¼xd	11½— 12xd	11¾	11½
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	7¼— 7¾xd	7¼— 7¾xd	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	½ %	4½— 5xd	4½— 5xd	4½	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	⅞ %	1 %	¾ %	½— ¾	½— ¾	⅝	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	7½— 8	7½— 8	7 1/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	5 — 7	5 — 7	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	106 —109	...	...
1,163,000$	Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	105 —110	105 —110	...	...
160,100*l*	Do. do. do. 6 % Ster. Bonds ...	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	12 — 13	11 — 12	12	11⅜
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
26,000	*Chelsea Electricity Supply, Ord., Nos. 1 to 10,277... ...	5	5 %	5 %	6 %	8 — 9	7½— 8½	8¼	7½
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½ %	4½ %	4½ %	115 —117	115 —117	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	26 — 27	25 — 26	26¼	23¾
10,000	Do. Prov. Certs. Nos. 90,001 to 100,000 £5 ...	10	...	...	...	18 — 19	17½— 18½	18	15 7/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17½	15 — 16	16	15
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	129 —134	127 — 132	130½	128½
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	*nil*	13 — 14	12 — 13	13⅜	12
10,000	Do. do. do. Nos. 30,001 to 40,000 £4 paid.	10	...	...	...	6½— 7½	6 — 7	6⅜	6
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14 — 15	14½	14
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400 £4 paid	5	...	...	...	3½— 4½	3½— 4½	...	...
10,000	House-to-House Electric Light Supply, Ord., 101 to 10,100	5	...	...	4 %	8½— 9½	8 — 9	8¾	7¾
10,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	10½— 11½	9½— 10½	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	15 — 16	14 — 15	15½	13½
220,000*l*	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	117 —121	117 —121	119½	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	17½— 18½	15 — 16	...	...
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½ %	10½ %	14½ %	16 — 17	15 — 16	16	15
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	8½	...
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	107 —110	107 —110	107	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2 — 2½	2 — 2½	2⅜	2⅛
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	15 — 16	14½— 15	15	12½

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation June 15th.	Closing Quotation June 22nd.	Business done during week ended June 22nd, 1898. Highest.	Lowest.
30,000	British Electric Traction	10	...	...	...	15⅜ — 16¼	16 — 16½	16⅝	16
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 £7 pd. (issued at £2 10s. prem. all pd.)	10	...	...	...	7½ — 8	10½ — 11	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅜ — 2	1⅜ — 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2⅛ — 2⅜	2⅛ — 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	9¾ — 10¼	9⅞ — 10¼	10⅛	10
129,179	Do. do. do. £6 paid	10	...	...	...	5¾ — 6¼	5¾ — 6¼	6	5⅞
59,254	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼ — 1⅜	1¼ — 1⅜	...	...
67,680	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼ — 4⅜	4¼ — 4⅜	...	...
630,000*l*	City and South London Railway	Stock	1 3/16 %	1 1/16 %	1⅛ %	68 — 71	68 — 71	69⅞	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £2 pd.	10	...	...	...	1¾ — 2¼	1¾ — 2¼	...	...
82,850	Crompton & Co., 5 % 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	88 — 93	88 — 93	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5⅛%	...	2¼ — 2¾	2¼ — 2¾	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5⅛%	...	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	103 —105	103 —105	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	...	2⅛ — 2⅜	2⅛ — 2⅜	2 1/16	2⅛
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	...	3⅛ — 3⅜	3⅛ — 3⅜	3⅛	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	106 —108	106 —108	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼ — ⅜	¼ — ⅜	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	5/8 — 5/8	¼ — ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	21½ — 22½	21½ — 22½	22¼	20⅜
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	19½	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	2⅞%	3¼%	10,⅞ — 10,⅝	10⅜ — 10½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15⅜ — 16¼	15⅜ — 16¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 38	35 — 38	37	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	124 —127	116 —119	120½	115

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.

House-to-House, 4½% Debentures of £100, 105—108.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—14; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8½. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10%.

London Electric Supply Corporation, £5 Ordinary, 3½—4.

*T. Parker, £10 (fully paid), 15.

Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8¼—8¾. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (June 2nd, 1898).

THE MUNICIPAL ELECTRICAL ASSOCIATION, 1898.

ELECTRIC TRACTION.

By Robt. C. Quin, A.I.E.E., B.E. and T. Engineer, Blackpool.

It goes without saying that the subject of electric traction is so important and extensive that it is impossible to deal with it comprehensively in a paper of this description. The author proposes, therefore, to set forth as briefly as possible the salient points of the subject and to invite discussion upon them, rather than to detail at length any particular system or systems of electric traction.

Road.—In the author's opinion, the road, or permanent way, is one of the chief factors which determine the success or failure of any electric traction undertaking, inasmuch as its condition will have a much greater effect upon the maintenance costs, and consequently, the financial result, than would probably be the case with any other system of traction.

Considerable difference of opinion seems to exist as to how this track should be constructed—whether the rails should be 43 lbs. per yard as upon the Giant's Causeway line, or 92 lbs. per yard as upon the Blackpool line—whether the gauge would be 3 feet or standard gauge.

The weight of the rail must, of course, be proportioned to the weight of the cars running thereon, and to the soil upon which the rails are laid; but it would appear to the author that the present practice errs too much on the side of lightness.

It will be admitted on all hands that smooth running is essential to the longevity of the rolling stock; and that this cannot be attained without rigidity of construction, smoothness of running surface, and accuracy of gauge.

In order to insure these desirable ends it is essential, in the first place, that the track should be well laid on a good solid foundation, accurately gauged, and substantially cross-tied. The usual cross-tie for tramways purposes is 1½ inches by ½ inch strap hammered round at each end, and threaded and bolted through the web of the rails; but at Hamburg—at which place it has been the author's privilege to investigate the permanent way construction—things are done on a decidedly better plan. Here the rails, which weigh 106 lbs. per yard, are cross-tied by an I shaped girder, 4 inches deep, which passes under the bottom flanges of both rails, and is secured at each end by two substantial and adjustable chairs. These ties are placed about 6 feet apart.

The rails also are not butt jointed, but have a half and half lap joint, with a longitudinal cut through the web about 10 inches in length. The fish plates securing these are 2 feet 10 inches long fastened by six ⅞-inch bolts. The fish plate on the tread side of the rail passes under the bottom flange as far as the web.

This class of rail joint is one which, in the author's opinion, very nearly approaches the ideal. It has unbroken running surface, is rigidly constructed, and has a large rail to rail contact.

The cross-over roads at Hamburg are also of unique construction. At these points the groove of the rail is gradually shallowed until at the actual crossing point it is ¾ inch as against 1¼ inches at other parts of the rail. The flange of the wheel projects 1 inch; hence at these points continuity of running surface is attained by riding on the flange of the wheel.

Generator.—Shall it be high speed, slow speed, direct coupled, belt, or rope driven: if with the latter shall the fly-wheel be placed upon the engine or the dynamo—are questions which have been ably dealt with in the technical press by Mr. J. S. Raworth. On the question of fly-wheels, the author begs to state *his* opinion that the fly-wheel should be left at the factory, as there is quite sufficient fly-wheel effect in a tramcar. The author further ventures to suggest that what is required is not so much uniform speed of the engine, or uniform E.M.F. of the line, as uniform motion of the tramcars, and, in his experience, neither of the former are absolutely essential to the attainment of the latter.

Slow speed engines, direct coupled and belt driven alike, are doing good service in traction work, both in this country and on the Continent. But of these, so far as regards modern plant, he cannot speak from personal experience. He has within his charge for lighting purposes, however, engines varying in speed from 80 to 5,000 revolutions per minute. The traction plant is of the latter order, *i.e.*, direct coupled, Parsons steam turbines, electrically governed. These turbines have been working since June, 1897, to the present time, and seem well adapted for the purpose. Their efficiency is extremely good; the attention and cost of up-keep at present extremely small, while the automatic regulation is everything that could be desired.

The extent to which this range of regulation is called upon depends, of course, in a very large measure, upon the weight of the cars, the number of starts per hour, the gradients, and, finally, the starting gear.

Motors.—Gearing and Starting Arrangements.

Motors.—The motors for traction purposes should certainly be of the enclosed type, as far as possible watertight; and their capacity such as to enable them, on an emergency, to develop, for short periods, at least three times their normal power.

The truck, carrying the motor or motors, should be rigid in construction—flexibility being given solely to the supports of the car body, and of the motor.

The efficiency of a traction motor, though, of course, an important point, is not of such great moment as with stationary motors. The question of weight, as well as efficiency, has to be considered; and the question, after all, amounts solely to how much power it will require to move the total weight of car, equipment and passengers, a given distance at a given speed, on a given length of track.

The efficiency, again, should be greatest at certainly not more than three-quarters of the maximum power of the motor, or preferably at its usual working load.

The arrangements for oiling should be such, that while giving efficient lubrication, oil should not be able to obtain access to the inner portion of the case. Certain makers of traction motors now cover the bottom coil of the field magnet with sheet lead. This is a good preventative of failure due to the access of moisture, dirt, or oil; but it would be better if these could be entirely excluded.

In the author's experience the weakest point in a traction armature is at the junction of the winding and the commutator. Great flexibility should be allowed at that point, and the armature coils and laminations cannot be too rigidly fixed. The sudden starting with heavy loads on heavy gradients is very apt to spring the windings, and snap their connection with the commutator.

There seems at present to be no settled practice as to the number of motors to be fixed upon a car. The author considers, however, that two motors should always be installed, either of which should be sufficiently powerful to take the car home in case the other breaks down. Further, that the starting arrangements should be such, that the two motors are placed in series with a resistance, and with one another at starting, and that under normal working conditions they should be in parallel, series-wound motors, of course, being used.

The question of gear now appears to be reaching finality, but it has passed through many phases. In the early days chain gear was generally adopted with doubtful success. Worm gear followed, but seems now to be gradually giving way before spur gearing.

The tramcars in the author's charge are at present all driven by worm gear. The worms are steel, 4¼ pitch, having three parallel threads. The worm wheels are gun metal. The whole is contained in an oil case. The worm is fitted with end thrust ball bearings. Worm gearing, if well fitted, is efficient, but the wear and tear are great, so that it does not long remain in an efficient condition. The worm gear is now being replaced by single reduction gear.

The nature of the controlling gear has an important bearing upon the economic working of a traction system. It has not only an immediate effect upon the revenue account, but affects also the life of the motors and of the generators, not to speak of the comfort of the passengers. Moreover, with good controlling starting gear, the maximum current taken momentarily by the car is considerably reduced, and with many cars working, and therefore many cars starting simultaneously, the amount of generating plant is most appreciably affected.

Within the author's experience, cases have arisen under working conditions of the maximum current being eight times greater than the normal; this, of course, being with crude starting gear. If this maximum were not to exceed the normal by, say, 50 per cent.—and it certainly need not—the necessary amount of generating plant would be very considerably reduced.

As bearing upon the question of the effect of controlling gear upon the life of motors, an incident which happened not very long ago may, perhaps, point a moral. A certain car, fitted with a series resistance and multiple contact switch as starting gear, stood upon a heavy gradient. The engineer in charge ventured to start the car, the immediate effect of which was to burn out a motor armature. On a second occasion, under similar circumstances, he again attempted to start, but this time burnt out the armature of one of the generators. But, not to be beaten, he repeated the operation under somewhat different conditions. The car was now equipped with a series parallel controller—the motors being the same. On this occasion he was successful, as on all subsequent occasions when this experiment was tried.

Cars.—Double-deck cars are almost invariably used in England for urban tramway purposes. The practice, however, on the Continent is just the reverse. With the exception of Paris, single-deck cars seem to be the rule. The correct size of a car and the number of passengers it should carry, are questions which cannot be settled until the conditions of traffic are known. If the line is double throughout a large number of cars can be conveniently worked. If it is a single line, and loops, the workable number of cars becomes limited, and their capacity therefore must be proportioned to the requirements of the traffic.

If the amount of traffic varies within wide limits during certain portions of the day, or at certain seasons of the year, it would appear to the author advisable to attach trailers to the motor cars at those times, rather than to carry a heavy dead load of car weight the whole time.

While on this point, the author would suggest that some better unit of efficient working might be established than the cost per "car mile." What is a car mile? Is it a trailer car carrying 15 passengers and weighing 3 to 4 tons; a motor car carrying 30 passengers, and weighing 7 to 8 tons; or a motor car carrying 80 to 90 passengers and weighing anything up to 23 tons? He would suggest "ton mile" as a better unit.

System of Feed.—The preceding remarks apply with equal force to all methods of electric traction, but the most debatable feature in the question is the means to be adopted of conveying the energy from the generator to the motor.

The trend of technical, as also of public opinion in this country, appears to be in favour of overhead. It is, the author believes, admitted by all that it is the cheapest method; but some have qualms as to its sightliness and safety. These points it is obvious, with a little skill and forethought, can be easily provided for.

Strong posts of ornamental construction are now obtainable, and when used for the joint purpose of lighting the street and supporting the overhead conductor cannot be objected to by the most critical.

The overhead line must always be in evidence, but it is remarkable how accustomed one can become to it, so much so as not even to notice its presence.

The best means of ensuring safety is good work, first-class materials, and sound construction. The gauge of the trolley line should be not less than 000 S.W.G., although 0 (B. & S.) appears to be the general thing on the Continent.

Two overhead conductors should be provided even for single line and loops, being, the author considers, cheaper in the end than spring frogs and other expedients.

Section blocks should not, under any circumstances, be placed in curves, also they should be provided (when trolleys are used) with guard checks to prevent the trolley wheel jumping the line when passing.

The span wire system of support appears best suited to high rates of speed, and is convenient in narrow streets where supports can be attached to the houses, but it necessitates a great number of straining wires at curves which are not sightly.

The life of the overhead line is greatly affected by the class of contact making apparatus which is employed. Certainly, the life appears longer with the rolling wheel than with the sliding bar. Whether the advantage which the bar has at curves and junctions sufficiently compensates for this, the author cannot say.

With a trolley line well erected and fitted with guard cheeks at cross-overs and junction frogs, there should be little risk of the trolley wheel jumping the line, but nevertheless, such a contingency must be provided for. In the first place, the trolley head, when free from the line, should not be able to rise to any great extent from its working position. In the second place, should it happen that the trolley jumps the line when the car is proceeding at high speed, and the head of the trolley locks against one of the supports (either bracket arm or span wire), something must give way. What will prove to be the weakest link cannot, of course, be given for certainty, but should it happen to be the trolley standard, accidents are likely to occur. The author suggests that it would be best to provide the weakest link in the shape of a loose trolley head, and that this trolley head should be anchored by an insulated cord to the trolley arm, say, 3 feet from the top end. The only result then of the locking of the trolley head would be its dropping free from the arm.

It is necessary, where telephone or telegraph wires crossing the overhead conductor, to provide some means for preventing these wires, in the event of their falling, from making contact with the overhead conductor. There are two ways of doing this: the first is to fix an insulator, such as a wood or other moulding, on the top of the conductor at those points; the second is to suspend above the trolley line one or more guard wires. These latter seem to be preferable, as in practice the wood moulding works loose, and makes considerable noise by vibration when the cars are passing. The guard wires should be stranded and capable of withstanding as great a stress as the trolley line itself. They should, the author also considers, be efficiently connected to earth. If this is so, a telephone wire coming in contact with the overhead line and the guard wire causes a short circuit and a cut-out at the generating station.

With overhead system a rail return is almost invariably used, and, therefore, the question of bonding and of the earth circuit should be considered at this point.

For all practical purposes the conduction from rail to rail by fish plates and bolts must be neglected, and it becomes necessary to provide electrical bonds across these rail joints of the same equivalent area as the rail.

The rails the author is now using have an area equivalent to a square inch of copper. The bonds consequently should have this section. Under these circumstances it is preferable to use two bonds, as one of a square inch section would be inconvenient.

The heads of the bonds should have a contact area of at least 2½ square inches, and should be of such construction as not to render them liable to work slack. It is a good thing, in calculating the fall of potential upon a given line, to allow 20 per cent. for increased resistance due to the slackening of the bonds. Even with this bonding, unless the disposition of the gas and water mains has been carefully considered, the Board of Trade limit of stray earth current is likely to be exceeded.

If a gas or water main crosses the track or approaches the vicinity thereof, and from that point takes a shorter route to the neighbourhood of the station earth than do the tramway rails, or has along that line of route a less resistance than the corresponding tramway return, it will take a greater proportion of the current than is allowable; then, parallel to that gas or water main, an insulated conductor should be laid from the point of the tramway rails above mentioned to the negative terminal of the dynamo.

Conduit.—The local conditions necessary for the successful working of a conduit system are, the author considers, freedom from sand and mud on the roads, good drainage, and a wide slot. The conductor should not be visible from the surface of the street, and should be fre-

quently supported on insulators. It is necessary to have a wide groove in order to obtain an efficient form of collector or plough, as not only has it to contain the insulated conductors, but it must also be mechanically strong. The groove of the conduit should in all cases be parallel to the lines, and the conductor should not be continued across the points or cross-overs, as in these cases it would necessarily be exposed.

Generally, conduits contain two insulated conductors, and this, to the author, seems preferable. It cannot be said that conduit systems have, up the present, been successful enough to warrant their general adoption. Recently, the author inspected four different conduit systems, but only two of these were then working.

The initial cost of a conduit system varies from 30 to 200 per cent. in excess of the cost of an overhead system, and the up-keep, even where the conditions are favourable, is about 10 per cent. greater than with the overhead.

Accumulators.—The accumulator system of traction certainly possesses very great advantages, the principal of which is that the service of cars is not dependent on the maintenance of one system of feed, each car being entirely independent; but we have carefully to consider at what cost this independence is obtained. The crux of the whole question is the cost of carrying a useful load of passengers a certain distance, and for this purpose it is as well to see how the question is affected by the adoption of storage cells. There are three heads under which additional expenditure is entailed; first, the interest upon the additional capital required for the installation of the cells, and also their depreciation; second, the cost of propelling the additional dead load; third, the inefficiency of the cells.

With cars running all day with one charge, the weight and cost of cells are both very great as a comparison of the cars used in Dresden for overhead line only, and of the cars at Charlottenburg for accumulators, will testify. Dresden cars, carrying 40 passengers, weigh 8 tons; Charlottenburg cars, carrying 42 passengers, weigh 23 tons. In both cases the useful load of passengers is approximately 3 tons. The cost of the accumulators used on the latter cars is about £750 per car.

The cost of traction accumulators varies from £75 to £125 per ton, the former figure being for rapid charging and discharging short-distance cells.

The author was much interested in the statements made by Mr. Epstein in his Institution paper (on the authority, he believes, of the Hanover Tramway Company) that the cost of the accumulator system of working there was only ·2d. per car mile greater than the overhead system, and he must confess, when making his recent visit to Hanover, he did so with the intention of ascertaining how that ·2d. was arrived at. To a certain extent he was unsuccessful, the cost of the up-keep of the cells not being obtainable; but he believes that the figures which he has obtained are sufficient to effectually disprove that statement.

There is in Hanover one line of rather less than 10 miles worked entirely by accumulators, the cars working that line being also equipped for the overhead, so that they are interchangeable with cars working on the combined system. They weigh 11½ tons, and carry 36 passengers. The time occupied in running this journey, exclusive of charging and stoppages, is 45 minutes. The cells are charged at two stations *en route*, at one of which eight minutes charge is given at constant potential, and at the other 25 minutes. The accumulators are placed under the seats, each car being fitted with 208 cells of Tudor type, and there are three plates in each cell. The weight of these cells is approximately 2 tons, and the installation cost of each car £200. *The energy taken per car mile on this track was* 1·5 *units.*

Although the up-keep cost of the cells was not obtainable, the average life of the cells was given at about 18 months, and, moreover, additional cars have to be provided on the accumulator line, as several cars are always occupied charging.

There is also another line at Hanover worked on the overhead system. Here the cars carry 32 passengers, and weigh 6 tons. *The energy taken per car mile of these latter cars was* ·68 *units.*

On the *combined overhead and accumulator* system, with cars similar to those in use on the accumulator line, the *energy taken per car mile was* 1·37 *units.*

Leaving the initial cost of the accumulators out of the question, there is the effect on the revenue account to be considered.

With rapid charging low capacity cells (which are really the only ones worth considering), the weight of cells for a five miles' journey with one charge is about 1 ton for every 3¼ tons of car and passengers. Therefore, with a car and passenger load of 13 tons, we must have 4 tons of accumulators. As every ton mile on a given road requires the same expenditure of energy, it follows that the energy given to the motors to propel this car will have to be increased approximately 30 per cent.

Opinions differ as to the efficiency of these cells, but generally the users of them consider that the watt-hour efficiency is about 60 per cent., and the author does not think the figure is far wrong. Therefore, the energy of charging these car-carried cells has to be increased 117 per cent., owing to their inefficiency and weight. Further, the wear and tear of the road and cars is increased by the additional weight.

The life of the plates of the cells is variously given by the users as from one to two years, by the representatives of the makers as from two to three years; but the majority of the users do not find much difference between the life of positive and negative plates. The cost of the up-keep of cells is given by the various tramway companies using them, at from ¾d. to 3¼d. per car mile, and the author thinks a fair average may be taken at 1½d. Assuming the cost of current to be ·75d. per unit, and ·7 of a unit to be taken without cells, figures the author does not think advocates of accumulators will cavil at, the cost of energy with the overhead system would amount to ·325d., and with accumulators to 1·14d., or an additional cost of ·62d.

This added to 1½d. for the up-keep of the cells per car mile, gives us the additional cost of 2·12d., neglecting the extra wear and tear of the cars and road.

Now consider the capital cost. The overhead system per mile of double track costs complete, including bonding of the rails, steel posts (on span wire or bracket system) about £1,600. If these posts are used for street lighting purposes, the cost of the posts should be divided equally under the two heads, reducing the overhead cost to £1,000 per mile of double track, with a 2½ minutes' service, and cars travelling eight miles per hour there will be six cars on the mile section, and, with the weight of the accumulators given, each car would cost £300 to equip, or £1,800 per mile of double track.

Again, if charging stations were adopted with, say, 15 minutes' charge, six additional cars would be required at an additional cost per mile of £560, making altogether a sum of £2,360 per mile.

With a slow service of cars the initial cost of the accumulators would probably be less than the overhead, but the additional cost of 2·12d. per car mile (with only 20,000 miles per car per annum) capitalised is equivalent to the sum of £3,530, bearing 5 per cent. interest for each car running.

Combined Systems.—Various combinations of the three systems before enumerated, have been adopted. More generally, it is a combination of the overhead line and accumulator system, but in all cases of which the author has cognisance, the adoption of accumulator systems has been not a matter of choice but of necessity.

When the necessity arises, the author would desire to point out most strongly that the dead load of the cars in proportion to its useful load, should be as small as is compatible with stability of structure. That arrangements should be made that the additional dead load of the accumulators is carried only so far as is absolutely necessary. It is therefore advisable to so arrange the battery that it can be detached as a whole from the car at the junction from the overhead line.

A great deal has been said from time to time as to the effect of the acid upon the cars and trucks, and of the odour of sulphuric acid which pervades the cars when the cells are placed under the seats. From what the author has seen of modern systems constructed on these lines, he can give his assurance that these complaints are not well founded; and, if it were not for the inconvenience of detaching the battery as a whole from the car under these circumstances, he would certainly recommend the cells being placed beneath the seats.

Where the conditions are such as would permit of the working of a conduit system, and in the absence of permission to use the overhead, the author considers the combination of overhead and conduit much more preferable than the use of accumulators. The additional weight carried is negligible and the working cost decidedly lower than with accumulators.

There have been many attempts to devise improved methods of electric traction, to obviate the disadvantages of the systems above remunerated, but they, one and all, have drawbacks peculiarly their own, which have hitherto prevented their general adoption. The names of these systems are legion.

The conclusions arrived at by the author all tend to the opinion that in the present state of electric traction engineering there is but one good and reliable and cheap system, and that is the overhead. Where a combination is necessary and conditions are favourable, overhead and conduit combined comes next in order of merit. That as at present constructed accumulators are not, from a commercial point of view, a satisfactory solution of the traction problem.

ELECTRIC TRACTION.

By J. E. STEWART, Borough Electrical Engineer, Derby.

THE paper I venture to lay before this Association will, I fear, be disappointing to my engineering brethren, as it will more concern the chairman of committees, and gentlemen who have the responsibility of leading the policy to be pursued by corporations, and of voting the necessary funds for the purpose of carrying out such schemes, and what I have to say is with a view of promoting discussion, and to obtain the advice of these gentlemen so that other or all towns may see for themselves what is the best policy to be pursued with regard to street railways or tramways that this Association can recommend. I do not wish it to be understood that I necessarily recommend or advise upon any of the points I lay before you, but do so solely with a view of gaining myself the knowledge of what you consider the best course to follow.

There are several towns which are now considering the question as to the advisability of buying up the existing horse tramlines, and are wondering what is to be done with them if they become corporate property, and some are trying to arrive at that stage when they are prepared to vote for an electrical equipment, and then, further on, what scheme of electrical traction shall be adopted; after that, whether a separate power house shall be laid down, or the current taken from their existing plant in the electricity supply works.

Starting with the assumption that the electricity supply works is now in the hands of the corporation, and that the tramways are also the property of the corporation, and that it has been decided to equip the same with electric motor cars.

The first consideration is, shall the current be supplied from the existing works?

This, I believe, should be answered in the affirmative, for the sufficient reasons that the same buildings, boiler, power and plant, will answer the purpose, and the necessary spare plant will not be augmented, but, on the contrary, considerably reduced in proportion to the output, as accumulators would be introduced to, as far as possible, reduce the necessity of adding plant to take the load over the

lines, when the maximum load for the ordinary supply occurs at the same time as the traction load.

Secondly, the cost of keeping accounts will be very much reduced, as the work that is necessary to keep the electricity works accounts will not be added to as would be the case when a separate power house is laid down.

The power used would be metered as for an ordinary consumer, and charged for as such.

The interest and sinking fund on the capital outlay on buildings will not be increased, or only slightly so, which would not be the case if a separate power house were decided upon.

The same staff of men would practically do, or, in any case, with a small increase only necessary.

The same engineer would, in consequence, control the whole supply, and would, of course, be handsomely recompensed for the added responsibility. I recommend Glasgow Corporation as a pattern to all our esteemed chairmen of committees. These have raised the engineer's salary to begin with.

Having decided so far, that the one works should do all the work necessary to supply electrical energy for whatever purpose it may be required, it cannot too carefully be considered as to what arrangements should be made to save confusion and friction between committees or the various departments into which the work of corporations is divided.

The committee, I think, should be composed of a definite number of gentlemen, which should be divided into two sub-committees. One to be responsible for the supply of electricity, arranging of prices and managing the supply works. The second to be responsible for the tramway's equipment and management, and each should report its recommendation to the ordinary committee meetings. The necessity for this, or some similar method of working, is as follows:—

Where tramways are laid down certain mains will have to be laid; at the same time arrangements could and should be made, where they have not already been made, for laying mains or ducts for the purpose of supplying current to the ordinary consumers along the line of route, and the apportionment of the work would be made by the committee as to how the capital charges should be allotted, and incidentally save the cost of opening the streets a second time.

All the posts, where any are used, should be arranged for the purpose of the electric lighting of the streets, and the charges treated in the same manner as before.

These considerations are reasons also why the engineer of the one concern should also be the engineer of the other.

This arrangement of committees would save any troubles as to difference of opinion as to the charges that are too likely to occur, when one committee is or may be trying to force the hands of another committee. At the same time, each sub-committee would be powerful enough to have the charges reconsidered at any time that was considered necessary, and also they would have all the information at their hands to come to a fair conclusion in the matter.

The charges of supplying service mains to the tramway premises should be borne by the electric supply works, and the current meters there and the feeders for the tramway system should be, of course, a charge against the tramway concern.

It will be apparent by this arrangement that the tramways will be in a far better position to pay its way than if it had to supply all the necessary buildings, plant and staff to run a system of its own, and the electricity works would be in a far better position to turn out energy at a cheap rate if its machinery is working all day at a full, or considerably increased rate of output, and consequently this would mean reduced charges for current all round.

The town will be the richer in every way from this arrangement.

Where the electric supply works are the property of a company, it is much to be desired that the whole supply should be controlled from the same works, as, in the course of time, most of these works will undoubtedly become the property of the corporation, but the price per unit must be arranged, and the supply given to the corporation with safe guards, in this direction; that the corporation shall not be called upon to pay (should they desire to purchase before the license expires) more for the machinery and plant used than that which it originally cost, less the sinking fund paid on same, and that the company's capital shall be valued less the profit made upon the supply to the corporation; that is, supposing the corporation supply increased the dividend of the company by 1 per cent., this would naturally enhance the value of the shares in the market, and the corporation without the safeguard would be required to find this amount should they determine to purchase before the license expires. There are difficulties in this arrangement, but it would be idle to say that they cannot be overcome. The difficulties will chiefly be those of apportionment of the cost of generating the current for the tramway supply, and of the apportionment of the profit made on this supply.

Conduit Systems.

The opinions expressed almost universally is that they are, for various reasons, undesirable, more especially where an ordinary system of horse traction is now laid down, as the cost of the conversion is so great, that it practically makes it impossible to make any adequate return upon the capital outlay; perhaps with the exception of where the traffic is so great, that there is practically a continuous stream of cars passing, but it certainly would be out of the question in outlying districts.

The enormous disturbance necessary to the streets is also a very serious matter, and the dislocation of the traffic during the course of the works, leaving out altogether the question of the cost.

Drainage is also a difficult matter, the cleaning of the conduit a constant source of expense.

Children's hoops and such like matter getting into the conduit are causes that make for damage to the collectors and stoppage of the cars.

Cushion tyre and solid tyred bicycles would be wrecked and personal damage done to the riders, not to speak of the modern narrow tyred carriage wheel.

Accumulator System of Traction.

The great advantages of this system are, that any car is self-contained—the speed can be varied considerably—not necessarily necessitating any disturbance of the existing road—although I fear there are few roads in the country that it would be economised, or upon which it would be safe to run accumulator cars without relaying the rails for these reasons:—

The great weight of the cars, and also the necessity of much stouter rails when vehicles are self-propelled—this is common to any sort of electric traction of course—but more so with accumulator cars, owing, as before said, to the great weight of the cars; and also, the average tramway groove is not deep enough for self-propelled traffic.

The disadvantages are:—

Great weight—about 30 per cent. of the total weight being taken up in the weight of the accumulators—which have to be carried whether the cars is carrying one passenger or is fully loaded.

The fact that it is practically impossible with our present experience to work satisfactorily on hilly roads, and the inability of attaching trailing cars—owing to the rapid deterioration of the accumulators.

The necessity of having to take the cars off the road for the purpose of having another set of cells put on board the car.

Smell of acid which will certainly get into the car, and it is very objectionable—it having the tendency of causing sneezing and consequent large absorption of whiskey to keep off the influenza which people are inclined to believe they have caught in consequence.

Rapid deterioration of the plates, and consequent heavy cost to keep up. This item alone is the principal cause of the want of success.

The course of construction is somewhat on a par with the overhead system, varying with the number of cars run per hour.

System depending upon automatic devices for the purpose of making contact at stated places as the car passes over, or on which one has to rely for the purpose of making the disconnection, are, for obvious reasons, out of the question—even if the only reason was the great number of such automatic devices necessary, and the likelihood or possibility at any time of one not acting properly, thereby causing a pressure of 500 volts to be exposed on the road for all and sundry to come in contact with.

The Overhead System.

This system is by far the most economical to work, and the up-keep is also the lowest.

The greatest argument in its favour being that, with this system, it can readily be charged to accommodate itself to any great or small improvement that may be made from time to time in the system of electric traction in the future, with the least waste of installed plant. But I anticipate that these improvements are only likely to be made in details.

The maximum degree of flexibility is obtained by this system also.

Trailing cars can be added and the average speed kept up. This also applies to the conduit system.

And perhaps the strongest reason for adopting this system is that every town which has sent deputations around to gather information has reported in its favour, and that it is found cheaper to work, completely under control, and that the overhead equipment is not considered or found to be an eyesore in the towns where it has been properly installed.

The argument that the overhead line is in the way of fire escapes is got over by the fact that most modern escapes are made for transport in a horizontal position, and a pair of pliers and rubber gloves is a simple way of overcoming the difficulty if the fire occurs on the route of the line, and it becomes necessary to stop the service before the engine and staff can arrive to switch of at the stated section.

Additional Reasons why Mechanical Traction should be Adopted.

Three electric cars can carry as many passengers and travel the same mileage as four horse cars, with a consequent saving of the wages of one driver and conductor; or, putting it another way, with the same number of cars costing the same for drivers' wages and conductors' also, 30 per cent. more miles can be run with quite 30 per cent. more customers, as, what has been proved in every case with both railways and street traction is, that the faster and greater the service the faster the receipts go up.

A Few Considerations why Local Authorities should have the Control of the Tramway System.

Firstly, all streets and work carried out under or upon them should be under the local authority. It is common knowledge and experience that, whenever a street has been carefully laid and repaired, there the gas company, &c., come along and begin cutting it about; whereas, if the whole of the matters concerning the streets and what is below was under the corporation control, these matters could in 50 or 60 times out of 100 be done just before, or whilst the repairs were under way, thereby saving great expense, and criticism from the ratepayers.

The whole of the inhabitants are directly interested in rapid transit, therefore, it is to the town's advantage to own the tramways.

Also, it is much better to raise revenue by indirect taxation than by rates; therefore, all towns should get as much control of such means of obtaining revenue as possible. We all feel some compunction in

the paying of rates, but none of us object to pay a price for an article, or a service done for us, a part of which goes towards paying rates or reducing the existing rates.

When to Purchase.– Given that a local authority has decided to take over the street system, and to equip it with an electric system of traction; I believe it would pay any corporation to obtain control of the system at the earliest possible date after having once made up their minds to do so, and this time I believe might, with advantage, be about three years before the license lapses, for one very strong reason; it would prevent the tramway company from laying rails during that period which would not be serviceable for electric cars. And it would also prevent the liability of the corporation being placed in the position of having to find the cost that a company could, if they so desired, make a corporation pay by relaying, during the last year or two, the whole system of rails, and those rails not suitable for the purpose of power traction; and thereby making the purchase as expensive as possible with a view of choking them off.

If this course, viz., the purchase was made at the earliest date possible, the corporation, of course, would have to pay, as part of the purchase, the dividends that might or would be paid during the number of years that still remained before the license expired, also the directors' fees, and should the manager, &c., or other officials be dismissed in consequence, it would only be fair to compensate them also; but with all this, it would be much cheaper in the end to purchase upon these terms, than necessarily leave the purchase until the last minute.

The following figures are taken from three small works and three large ones.

The small works generate the increased number of units generated, at the average cost of 1·043d. per unit.

Adding a proportion of the charges for interest and sinking fund, brings the cost up to 1·243d. per unit.

Works.	1895. Units sold.	1895. Total costs.	1895. Per unit.	1896. Units sold.	1896. Total costs.	1896. Per unit.	Increase units sold during the year.	Cost of generating the added units.	Cost of added load per unit.	Cost per unit for interest and sinking fund.	Total costs interest and sinking fund per added unit generated.	Charge per units tramway section.
Edinburgh	888,335	£6,181·33	1·67	1,721,557	£8,105·66	1·13	833,238	£1,924·33	·55	·2		
Manchester	1,748,244	£13,111·83	1·80	2,508,588	£15,156·05	1·45	760,344	£2,044·22	·64	·2		
Westminster	2,830,396	£27,242·55	2·31	3,503,054	£30,505·76	2·09	672,658	£3,263·21	1·16	·2		
								Average	·783	·2	·983	1·983d.
Nottingham	171,654	£1,995	...	297,185	£2,687	...	115,531	£692	1·43	·2		
Huddersfield	227,753	£2,723	...	304,163	£3,003	...	76,410	£280	·88	·2		
Portsmouth	406,118	£3,486	...	839,392	£5,980	...	433,174	£1,494	·82			
									3·13	·2	1·243	2·243
									1·043			

Therefore it is shown that these works could afford to sell that number of units at 1·74d. per unit, and make a handsome profit of ½d. per unit on the transaction.

And the larger works show as to what the costs are likely to fall to, with the growth of electricity supply works.

The total works' costs for the increased number of units generated is shown to average ·783d. per unit, and with the added allowance for interest and sinking fund on the capital outlay of ·932d. per unit, showing that these works could afford to supply electricity at 1·483d. per unit, at a profit of ½d. per unit as before. The interest on the capital is calculated at 3 per cent., and the sinking fund at 3 per cent. also; therefore, above the ½d. per unit profit shown, an allowance of 6 per cent. is paid already on the capital outlay.

REPORT OF THE CAPE OF GOOD HOPE GOVERNMENT ELECTRICIAN AND INSPECTOR FOR THE YEAR 1897.

Treasury, Cape Town,
Cape of Good Hope,
March 14th, 1898.

REPORT OF THE GOVERNMENT ELECTRICIAN AND INSPECTOR FOR THE YEAR 1·97.

The Assistant Treasurer.

(1) *Work done under the Appointment.*

Sir,—Application has been made for statutory powers for electrical supply. Such powers are granted in England in the form of a provisional order of the Board of Trade, such procedure being less expensive than that of a private Bill, and securing uniformity in the conditions of concession and liabilities. A model order, following the form of provisional order of the Board of Trade, has been drafted, but, as the matters dealt within it are for the most part beyond the limits of the Electric Lighting and Power Act, 1895, which relates almost exclusively to securing the safety of the public and the protection of telegraphs, consideration has been given to the necessity for and the terms of further legislation on this subject.

No new mains for electric supply have been laid in Cape Town, and only a few extensions have been made in the suburbs of Cape Town, owing to the fully loaded condition of the generating plant in each case.

The remarks in my Report for 1896 upon the unsatisfactory condition of the electric supply system in Cape Town, and the absence of systematic testing, appear to have been justified by the occurrence of several fires which have been attributed to defective wiring. These defects having been on private property, cannot be dealt with by the Government, but the matter having been referred to me, I have pointed out that the fire insurance companies have in their own hands a remedy which is most satisfactorily applied in Europe and in America, namely, the enforcement of regulations for proper insulation and workmanship.

The Government Electrical Laboratory, which has been so well and liberally accommodated for nearly two years at the South African College, has been removed to a room in the General Post Office.

The system of electrical measurements by potentiometer has proved to be suitable for the purpose of this Laboratory, and the standard cells which are relied upon in this system have been compared together once a week, and have been found to agree well together.

A number of voltmeters and amperemeters have been sent to the Laboratory by the Cape Government railways and from the Royal Observatory for comparison with the Government standards, and a voltmeter and an amperemeter belonging to the Town Council of Cape Town were tested at their works, the current, 400 amperes, being more than could be obtained at the Laboratory. Only one supply meter has been sent in for examination. A recording voltmeter for the Tramway Company has been tested, and testing instruments have been lent to the General Post Office and to the Cape Town and Suburban Electric Light Company.

I have been further indebted for voluntary assistance in the Laboratory to Mr. W. H. Logeman.

The electric tramway in the southern suburbs of Cape Town, from Rosebank to the Liesbeek Bridge, was inspected on June 3rd. The Port Elizabeth Electric Tramway, from the corner of Walmer Street and Union Street to the corner of Prince Alfred's Park, was inspected on June 14th; and on July 19th the hill sections of the Port Elizabeth tramways were inspected, and careful tests were made of the brakes on the unusually steep gradients, under various conditions of speed and wetness of the rails. These tests gave very satisfactory results, and the plant and equipment of the Port Elizabeth Tramways is in general well designed and constructed. On August 17th the Cape Town Suburban Tramway from the Liesbeek Bridge to the Crown Hotel, Claremont, was inspected, and all these sections of tramways, after certain alterations, were opened for public traffic.

After the Cape Town Suburban Tramway to Claremont had been at work for a few weeks, tests showed that the electric pressure causing leakage of electric current in the ground between the tramway works and the end of the rails, largely exceeds the limit permitted by the regulations. Calculation showed that at this rate the pressure between the Wynberg terminus of the line and the works would be about 6½ times the limit permitted by the regulations. After being called upon to comply with the regulations, the tramway company somewhat reduced this pressure by replacing certain defective work which had been destroyed by electrical corrosion underground.

The remainder of the line as far as the terminus at Wynberg was inspected on December 28th, and a test of the pressure was made between the works and Station Road, Wynberg. The pressure was found to considerably exceed the limit permitted by the regulations, and the leakage, which has seriously disturbed, and in some cases has suspended, the telegraphic service, is corroding the water-pipes underground. The line was conditionally opened for public traffic in order to afford the tramway company time for taking steps to remedy this defect.

Several accidents, including an outbreak of fire, have been caused by the fall of the telephone wires across the trolley wire. The tram-

way company have not hitherto been called upon to protect, in accordance with the Regulations, wires which cross the road in groups of less than six, but this exemption has now been withdrawn.

Other tramway accidents, one having a fatal result, have occurred, but not being of an electrical nature, they have not come officially under my notice.

(2) *Work other than under the Appointment*

On my visit to Port Elizabeth in June I inspected the telephone lines with the view of re-arrangement with regard to the tramways, and to the site of the new Post Office.

In July I inspected and reported to the Department of Public Works upon the generating plant for electric supply in the General Post Office at Cape Town, and on the electric lifts in that building, so far as related to their conformity with the specification.

Alterations in the electric lighting of the Assembly Chamber and of the Council Chamber of the Houses of Parliament, and schemes for electric lighting of the Valkenberg Asylum and on Robben Island, have been referred to and reported on by me.

The Municipal Councils of Queenstown, Worcester, and Cradock have applied to me for advice on general electric supply, and on the utilisation of water-power for this purpose, and tenders for the supply of machinery have been submitted to me. I have reported that since no specifications had been prepared the tenders were not satisfactory; they were not sufficiently explicit; could not be compared, and none should be accepted. I recommended that a consulting engineer should be employed to act for these Councils.

The Municipal Council of Woodstock asked my advice as to the lighting of 120 street lamps. I reported that the running of a special electric lighting plant for such a purpose would be more expensive than gas lighting. I gave some information on a general electric supply for the district, and estimated the working expenses at about 7½d. per unit, exclusive of interest and depreciation.

Owing to numerous accidents by electric shocks from the tramway in Cape Town, the question of providing means to enable the police to give aid was discussed, and I drew up a set of instructions to the police.

I have been applied to for, and have given advice on, the equipment of a physical laboratory for the Huguenot College at Wellington.

In the Government Electrical Laboratory I have made comparative tests of the illuminating power of certain brands of paraffin oil, and I have, at the request of the Government Marine Biologist, constructed and experimented with an electrical thermometer for observing the temperature of the sea at different depths.

(Signed) A. P. Trotter,
Government Electrician and Inspector.

APPENDIX.

Government Notice.—No. 873, 1897.

Treasury, Cape Town,
September 13th, 1897.

The following instructions to the police with regard to their action in the event of electrical accidents are published for general information.

By order,
H. M. H. Orpen,
Assistant Treasurer.

Treasury, Cape Town,
Cape of Good Hope,
September 13th, 1897.

Electrical Accidents.

Instructions to the Police.

If a wire falls in a street in which the electric tramway runs, and the end hangs loose, or lies on the ground, the best thing to do is to *leave it alone* until one of the tramway company's staff comes. In such a case the best thing that a constable can do is to prevent anybody from touching the wire.

If a wire, as it lies on the street, is an obstruction to the traffic, it may be pulled on one side by means of a stick, a walking-stick with a hooked handle would do well, or it may be moved by using rubber gloves. It would be better to allow the traffic to be impeded than that the constable should leave the wire in order to get the gloves from the nearest station.

The thick wires which run above the middle of the street are called trolley wires. They convey the current to the cars. Smaller wires, called span wires, are stretched across the streets to support the trolley wire. Other small wires are erected in some streets for the purpose of preventing telephone wires from falling on the trolley wires. If a telephone wire falls and is kept by the guard wires from touching the trolley wires, or if it touches a span wire, and does not touch the trolley wire, no shock can be given by it. If the loose end is an obstruction to traffic, and if it can be drawn away and tied up without any risk of touching the trolley wire while doing so, this may be done. Rubber gloves should be used. If there is any risk of touching the trolley wire with the wire which is to be handled, it is better to *leave it alone*, and to see that nobody else touches it until a tramway man comes.

If a wire falls across a trolley wire, or the trolley wire itself touches the tramway rails, there will be a violent flash. When this flash occurs, an automatic switch at the tramway works will be opened, and the electric supply will be cut off on the section on which the accident has happened. The trolley wire is divided into sections of half a mile in length. As long as the switch is open, no tramcar can run on that section, and the wires are harmless. As soon as the attendant at the works sees the automatic switch fall open he will try to close it, in case the cause has been a momentary one. If, however, the wire still lies touching the rails, he will be unable to keep the switch closed. The same thing may happen if a wire falling on the trolley wire touches a tramway pole, electric lighting pole, telegraph pole, or other metal work connected with the ground; but this is not certain.

It is very undesirable to make a connection between a wire and the tramway rails or any other metal work intentionally, because the flash which will occur will be so brilliant that it will unnecessarily alarm the bystanders, and may so dazzle the constable who causes it to touch that he may be unable to see anything for a minute or so.

It is a good thing to keep the wire on the rail if it touches at all. It may be held there with a stick, but it is advisable not to hold it there by standing on it, since, if the rail is dirty, a slight shock, but enough to cause the person standing to fall, might result.

If the end of a wire hangs loose in the street, and is an obstruction to traffic, a rope or piece of strong string may be put round it with a "half hitch," without touching the wire with the hands, and it may then be drawn on one side. Great care must be taken in doing so, that it touches no other wire, pole, or metal work.

The electric pressure (560 to 570 volts) used by the tramway is not sufficient to give a fatal shock to a human being. It is sufficient to produce serious burns. The pressure used for electric lighting in Cape Town is 220 volts between any wire and the earth. The highest pressure between any wires accessible to the public is 440 volts; 220 volts would probably kill a horse. A pressure of 2,250 volts is used in Rondebosch and in the neighbouring districts, but the wires are not accessible to the public. The pressure on the service wires is about 100 volts.

If a wire falls on a person and winds round him, or becomes entangled in the clothing, the wire should be pulled away with a stick, or by wrapping the hand in a dry coat, or by means of rubber gloves, taking special care that the wire does not touch the skin either of the victim or of the rescuer.

A severe electric shock may produce sudden stoppage of the respiratory and heart muscles. If the stoppage of the heart's action is complete, it is doubtful if anything can be done; but in some cases the stoppage is not complete, and animation is only suspended. The condition is similar to that of apparent death by drowning, and the well-known method of producing artificial respiration should be resorted to without delay.

Summary.

If a wire falls harmlessly, leave it alone, and prevent anyone from touching it.

Only the trolley wire, or the wire touching it, does mischief.

The electric current is, as it were, always trying to pass from the trolley wire direct to the tramway rails, or through the earth to the rails.

A shock can only be felt when the body forms part of a path by which the current can pass from the trolley wire to the rails.

The electric current cannot pass through *dry* wood, cloth or rope.

(Signed) A. P. Trotter.
The Government Electrician and Inspector.

THE TELEPHONE INQUIRY.

(*Continued from page* 864.)

The Select Committee on Telephones sat again on Thursday, Mr. Hanbury presiding.

Sir James Ferguson said he was Postmaster-General from December, 1891, to August, 1892, and he joined the board of the National Telephone Company in 1896. Before he visited the Post Office on his appointment, he had an interview with the Chancellor of the Exchequer, when the Chancellor mentioned a matter of great difficulty in the Post Office, viz., the management of the telephones. Mr. Goschen pointed out that the telegraph revenue had been apparently injured by the operation of the telephones, and it was thought necessary to do something to put the matter on a better footing. The Post Office felt that the only proper course to pursue was for the Post Office to purchase the telephones, but the Treasury decided not to do that. He said he would endeavour to fall in with the policy of the Government, and very soon after he went to the Post Office he set the department to work to frame a scheme. He suggested that they should find out the Government's policy and the company's policy, and see how far they could be reconciled. The result was, that a scheme was submitted to the Treasury embodied in a Treasury Minute. A Bill was introduced by himself for the purpose of taking more powers by the Post Office, and to some extent the Telephone Company. That Bill was referred to a Select Committee, and, incidentally, the whole scheme of the Government was explained in detail. The Committee reported on the motion of Mr. Shaw-Lefevre, in favour of the Bill, but recommended that the terms of the licenses should not be extended. With that reservation, the Committee thought the responsibility of the agreement with the company should lay with the Government, but that the details should be laid before Parliament. That was the report of June 16th, 1892.

The Chairman: The reservation being that these licenses should not extend beyond 1911?—Yes; the chairmen of the companies urged that the licenses should be extended to enable the companies to recoup their capitals.

Continuing, Witness said the reservation referred undoubtedly to the

existing licenses. Moreover, there was so strong an assumption that the telephones would revert to the State in 1911 that the question of new licenses did not arise. The Bill passed both Houses with hardly any discussion. Still, the agreement with the company hung fire through the indisposition of the company to accept it, and their desire to get some better terms. As the Committee was aware, it was not until just before the Government quitted office that the agreement was initialed by himself and by the chairman of the company. Those heads of agreement had the full concurrence of the Chancellor of the Exchequer. They were studied with the greatest care by the Chancellor who went over them line by line, and he personally conducted negotiations with the chairman of the Telephone Company. He believed that the Chancellor had four meetings with Mr. Forbes, and he never knew a gentleman more closely cross-examined in his life. Only a few days ago Mr. Goschen informed him that he was responsible for every line in the agreement. He mentioned that because it seemed to be thought that the signing of the agreement before the Government left office was a hasty decision. That was plainly disproved before in the House of Commons on March 22nd, 1892, he stated in the plainest terms, the whole purport of the agreement. The two telephone companies who had absorbed all the others, introduced private Bills in order to obtain increased power for carrying on their business, because they were so restricted by the terms of their license that the system was greatly hampered. He opposed the second reading of the first of those Bills, viz., that of the New Telephone Company, and pointed out all that had been done.

The CHAIRMAN: All we want to know is how the heads of the agreement with the company were signed on the very evening that the Government was defeated. We have the facts that the heads of the agreement were well known to the Chancellor of the Exchequer representing the Government, as well as to yourself, and had his full concurrence. Now they were signed on the day on which the Government was defeated. Were they so signed with the knowledge of the Chancellor of the Exchequer?—Certainly. I must point this out that my honour is at stake in this matter. I submit to the Committee that it has been suggested here in many questions that this agreement was hastily entered into on the eve of the Government leaving office. I am concerned to point out to the Committee that the full terms then initialed were stated to Parliament repeatedly, not only on this occasion but before the Select Committee, and explained with the greatest detail without reserve. That is most important in view of the suggestions which have been made. I observe that at the last meeting of the Committee it was suggested that I had entered into an understanding with the chairman of the company before he signed the agreement, which was not contained in the Treasury Minute, and which I think it was stated was a secret understanding.

That was so stated?—Then it is an utter misapprehension.

In the first place the heads of agreement were signed with the consent of the Chancellor of the Exchequer and with his knowledge?—Certainly.

Was it a fact that the chairman of one of the companies objected to sign that agreement?—He was very reluctant to sign it, as he had been all along, and he only eventually signed it on my assuring him that it was the intention of the Post Office to carry out the granting of areas in a reasonable manner.

Did he act for both companies?—No; I think the Duke of Marlborough came in afterwards. I am pretty sure of that.

Was your assurance given to both companies, or only to Mr. Forbes, the chairman of the National Company?—As far as my memory serves me, I only remember giving it to Mr. Forbes.

Therefore, whatever the effect of that assurance, it can only refer to the agreement signed by the National Company?—It was not any new assurance. It was only a repetition of what had been stated before the Telegraph Bill Committee.

The heads of agreement were signed subsequent to this report?—Certainly.

If the agreement was to carry out all that had been arranged or said before the Committee, why was this promise, instead of being a verbal one, not put into the agreement?—The answer is that it was clearly understood that these areas are subject to further arrangement.

That is in the agreement. It was with these words that Mr Forbes found so much objection, that he would not sign until he had got a verbal promise?—Yes. I said to Mr. Forbes: "Certainly, the Post Office will carry it out in a reasonable manner," and my successors have done so.

The CHAIRMAN, to Mr. Lamb: That is what you said?

Mr. LAMB: That was my evidence before the Committee.

The CHAIRMAN, to Sir James Ferguson: Who was present when the agreement was signed?—I should think probably Sir Arthur Blackwood and Mr. Lamb.

Was any record made of it?—I cannot tell you.

I tell you frankly why I ask all these questions. It is simply this: the Post Office have very largely extended the areas which were conceded to the company under the agreement, and I gathered from Mr. Lamb that the Post Office rather took the view that in consequence of your promise the Post Office were under some obligation at the request of the company to enlarge these areas. The agreement does not say so?—Second-hand evidence is not worth much, but I used from time to time to ask Mr. Arnold Morley how the agreement got on, and he said that the settling of the areas was a very difficult affair, and took a long time. I had a relative on the directorate of the company, and he told me the same thing. I assure the Committee that the view I took, and the view I always understood was taken, was that it was a great convenience to the public that the areas should be extended.

That may be so, but these areas have been extended by the Post Office since these questions regarding the Telephone Company reached an acute stage, and unless there was some strong reason binding the Post Office to so extend the areas during this critical period, some members of the Committee might think that the Post Office should have held its hand. The agreement, as it stands, undoubtedly does not require the Post Office to do anything of the sort, but Mr. Lamb certainly seemed to think that your promise had rather forced the hands of the Post Office?—I never heard it suggested until Tuesday, and I believe that what I said to Mr. Forbes was simply in conformity to what was said before the Committee.

Did it go in any way beyond what was known in the agreement to the public?—Not in my opinion in the spirit of it, but certainly it did as to the letter of it. Mr. Forbes said he did not think it was plain, and I said he might be quite sure that the Post Office would come to reasonable terms about the areas.

Did anything you said to Mr. Forbes in any way bind the Postmaster-General, or qualify his discretion, or really convert the word "may" in this agreement into "shall"?—I can only repeat what I understood all along, that we were going to make reasonable terms about the extension of areas, and I assured him of that.

Further questioned by the CHAIRMAN, WITNESS said that no record was made of the promise. The Post Office knew what had been done, and if they pointed it out to his successors he considered they would be bound by it. He felt sure that Mr. Morley's views were exactly the same as his own in the matter. He sat beside him at the committee which sat in 1895, and they held exactly the same views, that in the interests of the public the areas should be reasonably dealt with. He thought any minister might say: "You may be sure that the Treasury will be fair," without any record being made of it. As to whether that might be thought to assume that the Postmaster-General would not be fair, he could only say that Mr. Forbes wanted something more, and that something appeared to be supplied by what he promised.

The CHAIRMAN: May I put it briefly like this. The heads of agreement say the Postmaster-General "may" do so. Did your undertaking amount in any shape to the pledge that the Postmaster-General must do so and should do so?—You may put it in that way that I thought the Postmaster-General should make such fair agreement.

"Shall" or "should?"—"Will;" that is what I understood by it; "will treat the company fairly in the matter of areas."

Is that not assumed already in the agreement?—I do not think it went beyond the agreement.

I put this concrete case. As I read the heads of agreement, it would certainly not have been incumbent upon the Postmaster-General to extend these areas during the present year of this rather acute crisis. The Post Office have extended them, and we gather from Mr. Lamb's evidence that they have extended them because they were pledged, not by the actual words of the agreement, but by these words, coupled with your assurance?—You may take it in that way. I left it in the hands of the Postmaster-General.

And therefore it would have been quite possible for the Postmaster-General to refuse the extension of these areas?—Certainly. It did not bind him to give an extension of every one.

Do you consider that the discretion of the Postmaster-General for the time being was absolutely unfettered, that your words did not bind him to grant these areas except under the heads of agreement as signed?—They expressed the sense in which I viewed that agreement.

Mr. BARTLEY: Do we understand really and truly that there was no verbal understanding outside this agreement in 1892?—I think not, unless you consider what I have said on this. That must be a matter of opinion.

Do you consider the Post Office only morally and legally bound by the terms of the agreement?—No. I think they were bound to interpret the agreement liberally and reasonably.

Further examined, WITNESS said he thought the Chancellor of the Exchequer agreed that there should be a liberal interpretation of the agreement. Mr. Forbes was reluctant to enter into the agreement because he considered they were giving up a really valuable part of their privilege, while at the same time the so-called concessions offered him were really necessary for the development of the business. When he (WITNESS) said that he was sure the Post Office would deal reasonably with the company in the matter of areas, he signed the agreement. It was the kind of thing which often happened.

Mr. BARTLEY: Must not the verbal arrangement have been very substantial to induce him to sign?—I cannot go beyond what I have said.

You wish the Committee to understand that this promise which changed Mr. Forbes's opinion as to signing the agreement, was so insignificant that it really did not amount to anything at all?—It did not amount to anything fresh beyond what was mentioned before the Telegraph Bill Committee.

Although it changed Mr. Forbes's opinion?—It caused him to sign it at the last moment. It did not change his opinion.

But we had it from Mr. Lamb that he absolutely refused to sign?—I do not think he flatly refused to sign.

Sir JAMES WOODHOUSE: Did you regard what you said as any qualification of the agreement signed?—Certainly not. It would not be binding on this Government if they chose to repudiate it.

By Mr. NICOL: The company held the trunk lines, and gave them up, and they had to make some concession to the company. He considered that the reasonable assurance he gave to the company was in the interests of the public, as leading to the further development of the system.

Questioned by Mr. COLVILLE: The agreement had led to an immense development of the telephone system. No application was made during his time by municipalities for telephone licenses. The first application of the Glasgow Corporation was in 1893.

By Sir JAMES HOWORTH: He was not so sure that the telephone

had increased in other countries enormously as compared with England. His impression was that it had not. The Commissioner at the Glasgow inquiry was of opinion that the rates charged in England were not excessive. He thought if the telephones were taken from the hands of the company they should be worked by the Post Office. He saw no objection in principle to the municipalities working the telephones, but he saw the greatest possible objection to having competing systems in the same area.

Mr. BENNETT was recalled, and answered a few more questions, and the Committee adjourned.

The Select Committee on Telephones resumed its sitting on Tuesday last, Mr. Hanbury presiding.

Mr. J. WILLIAMS BENN, chairman of the Highways Committee of the London County Council, in reply to the CHAIRMAN, said that, generally speaking, no preference was shown to the County Council as regarded charges by the National Telephone Company. For exchange lines they paid the list charges.

The CHAIRMAN: What is that?

The WITNESS: That is £17 per annum for a five years' agreement. He then gave particulars of the other charges which the company levied upon the Council for their various lines.

Can you tell us how far telephone users in London have suffered financially owing to absence of competition?—Yes; but before I go into that question I should like to refer to the offer made by the New Telephone Company in 1892 to supply London with an up-to-date service. The company was already in successful operation in Manchester, under the title of the Mutual Company, and whereas it started in February 28th, 1891, with only 66 subscribers, after 13 months' working it had over 1,000 instruments in connection. With regard to the disappearance of that company, he submitted that the telephone users of London since that date had been mulcted to the extent of the difference between the charge of 12 guineas, which the New Company offered the service for, and the £17 which was paid to the National Company. If an average of 10,000 subscribers be taken from 1892 to 1898, the difference in price, to be reckoned only at £4 per annum, it would show a loss to the telephone users of London of nearly £300,000. Some 3,000 firms entered into an arrangement to to be supplied with a service by the New Company at the 12 guinea rate.

By Mr. J. STUART: That was about May, 1892.

The WITNESS then referred to steps which the County Council had taken to ascertain whether the telephone users of London were satisfied with the existing service, and he said that in 1895, out of 2,500 subscribers communicated with, 1,305 were generally dissatisfied. They had just lately been sending round to ascertain what was the present position of those persons who were then complaining, and so far they had succeeded in dealing with 561 cases. They found that there were now satisfied with the service 8 persons, 53 had changed their address, 36 had discontinued through dissatisfaction, 245 were still dissatisfied for various reasons. The general summary of the complaints was as follows:—General inefficiency, 65; delay in getting connection, 213; indistinctness, 189; ringing off before conversation was finished, 196; failure to get connection on account of being engaged, 217.

Were they picked cases or taken haphazard?—Oh no, they were not picked cases by any means.

Can you tell me whether the London County Council have formed an opinion as to any substantial benefits which would be derived by their constituents from the working of the telephone service being in their own hands?—Speaking with a knowledge of the resolutions adopted last week at a conference between the Council and the local authorities of London, we say that if the Post Office will enter into the matter on the basis of honest and thorough competition, that there would be no necessity for the London County Council to take up this work.

But failing the Post Office doing as you desire?—Failing the Post Office, we could do very much better for London as regards price and efficiency than the National Telephone Company. We have advantages in regard to wayleaves, fire stations, and probably, through the co-operation of the local authorities, other public buildings, which would not be available to the National Telephone Company, and therefore, altogether, we could manage this thing more efficiently and cheaper.

That is a general statement—can you give us information as to where the particular advantages come in?—I think it would be better to refer you to the engineer for that portion of the evidence. From figures which were supplied by the engineer, I think it will be found that a telephone service can be provided for London at a charge of £10 per subscriber during the first five years, reduced to £9 afterwards, or possibly a smaller sum. Continuing, WITNESS said that on that basis they estimated that no charge would fall upon the county rate. It would be impossible for the Council to enter upon an undertaking that their license should terminate in 1911, without some provision that at all events their outlay up to that date should be forthcoming from the State. They would certainly ask for some guarantee that if their license terminated in 1911 they should receive back the structural value of their plant at all events. They would not ask anything for goodwill.

You don't think that the London County Council would put itself under the same terms with regard to purchase of their plant as the National Telephone Company?—No, I don't think in the interests of the ratepayers we could recommend such a course.

What is the shortest period the London County Council would think it fair to the ratepayers to undertake this work?—We could not undertake this work unless we had the whole of the life of the plant laid down.

And you put that at 40 years?—That is the average.

Do you expect to tap a different stratum of subscribers?—Yes. Our belief is that if the subscription in London were reduced to £10 or £9 it would induce a very large number of the class of small shopkeepers to take advantage of the telephone service.

When you speak of £10 you must recollect that there are two kinds of subscription in London—that for firms and that for private persons. Is your £10 for firms?—Certainly. We should be prepared to undertake private persons at a proportionate reduction. Continuing, WITNESS said that the position of the Council was rather different to that of provincial councils as regarded the control of the streets for the purpose of taking them up for the laying of lines, &c.

It would be within the right of a vestry to refuse to grant the County Council power to take up its streets?—That is so at present, but the London County Council would have to come to Parliament for powers, and it is quite possible that under such an Act, some provision might be made to remove that difficulty.

Would the London County Council ask for special powers, which are not given to its assumed competitor, the National Telephone Company?—I may say that if the London County Council were able to control the streets, as the National Telephone Company is, in conjunction with the Post Office, I don't think we should have any great difficulty in the matter.

Supposing the Post Office were to enter into the same agreement with you—as they have entered into with the National Telephone Company—as regards laying wires, would you require any fresh legislation?—Well, we should be able to proceed under that arrangement.

By Mr. BARTLEY: The National Telephone Company had paid substantial sums to the various competing companies which they had bought out. The purchase price of the whole 13 companies now represented by the National Telephone Company represented a capital of about 3 millions. He had analysed the figures, and had come to the conclusion that the constructional outlay of the company might be put down at £1,800,000, which left paper capital to the extent of £1,400,000, and a careful examination of the accounts of the company showed that the dividend to meet that paper capital had been almost entirely raised from London. Londoners were paying £76,000 a year in order to find the dividend on that paper capital.

Do you think that if competition were introduced into London we should get back the advantages which the National Telephone Company was anxious to prevent, by buying up the other companies?—Certainly.

By Sir JAMES WOODHOUSE: You are of opinion that competition would be a good thing?—I say that under present circumstances it is a necessity.

You say that the local authority would be the best competitor?—Yes.

By Mr. STUART: Where companies had been bought up in the country for considerable amounts, a reduction had been made in the charges, and London had had to pay the dividends of the company by its high rates.

The National Telephone Company is under no obligation to supply.—it may. In these figures that you have given us with reference to the London County Council, have you proceeded on the assumption that you should be under an obligation to supply as well as the right to supply?—Yes. We have regarded it as a great grievance in London that the National Telephone Company is not under any obligation to supply. We have received numerous complaints from persons wishing to have telephonic communication, but who the National Telephone Company refuse to supply, and we have in our figures taken it as an obligation to supply. The figures which he had placed before the Committee, continued the witness, only referred to the London County Council area, and he believed they could be very considerably improved upon if they included the National Telephone Company's area, which was much wider.

Replying to Mr. COHEN, WITNESS said that the figures he had given had not been approved by the London County Council in its corporate capacity. He believed, however, that they would be endorsed by the Council when opportunity offered.

By Mr. COLVILLE: He had considered the question of the London County Council competing with the National Telephone Company, and he believed that if it had a license, it would be able to compete successfully at reduced rates.

Sir HENRY HOWORTH: Your calculations were made upon the basis of not making any profit?—Yes; our idea is that we should serve the citizens.

Do you think that municipalities would be justified in embarking on a large scale on undertakings of this kind which are made for the needs of only a small portion of the community without a considerable profit?—I don't agree that the telephone service can be described as meeting the needs of a small class, because it must be evident that if the telephone is a necessary adjunct to commercial and business firms, then the advantages which result in an increase of business must extend to the carmen and the warehousemen. I say that the telephone service is necessary to business life of the country, and that it is in no sense a service which can be described as confined to the wealthy or business classes. Continuing, the witness said that unless the municipality was protected in the matter of telephone monopoly, the same way as it was protected in the case of gas and water undertakings, he considered it was their duty to step in and provide such a service. He had not contemplated the municipalities licensing the local authorities to undertake the work, as he thought it would be unfortunate to multiply the licensing authorities.

You say that the present company has refused to serve individuals—what inducement would there be for the company to refuse to supply, unless it was because they considered it would be too expensive?—The policy of the company, I believe, is that unless a sufficient number of persons in a district apply to be connected, they will not supply a single individual.

But surely you don't propose that the Municipality should introduce telephonic communication at a certain loss?—We say that in giving London a telephone service, we are bound to take the

unprofitable with the profitable. Just in the same way as the Post Office serves districts which are distinctly unprofitable, we say that we must do this with the telephone for the convenience of London.

Re-examined by the CHAIRMAN: You propose that the London County Council should work the telephone service at such charges as would just pay the cost, and not that a profit should be made for the relief of the general rates?—That is so.

Replying to further questions, the WITNESS said the London County Council had not considered the question as to whether they would prefer to limit the working of the telephone service to their own area, or whether they would go outside.

Sir ALEXANDER BINNIE (chief engineer of the London County Council) was examined in reference to his estimate which he had prepared for supplying London with a telephone service. He explained that the estimate was based on the supply of the Council's area only, and not the London area of the National Telephone Company. Supposing they were to extend the service, the estimate would have to be slightly increased. The estimate was not based upon actual tenders, but upon prices which had been furnished to him by various manufacturers.

What is your estimate of a service for London?—£8 per subscriber, exclusive of the Post Office royalty.

But including the royalty?—Then I arrive at the figures just given by Mr. Benn—£10 to commence with, and £9 afterwards.

How long do you calculate that a license ought to run?—To render it remunerative, I agree with Mr. Bean that a license should run for 40 years. Continuing, WITNESS said that supposing the County Council were granted a license now which would expire in 1911, he reckoned they would have to make a charge of £15 or £16 per subscriber.

Mr. BENN said that there would be a lower charge for private persons than the £10 or £9 mentioned in your estimates for business firms?—All my calculations were based upon a rental of £10 and £9 respectively. Of course, we might be able to make a reduction for private persons within their own limited district, but that question has not entered into my calculations at all.

The Committee adjourned.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by **W. P. THOMPSON & Co.**, *Electrical Patent Agents*, **322**, *High Holborn, London, W.C., to whom all inquiries should be addressed.*

12,617. "Improvements in the means or apparatus for controlling and regulating electric motors." C. A. CALUS WILSON. Dated June 6th.

12,631. "Tell-tale indicator for electric mast-head and side-lights of ships." A. R. TURNER. Dated June 6th.

12,636. "Improvements in electric switches." J. G. DIXON. Dated June 6th. (*Complete.*)

12,667. "An improved device for fitting reflectors, shades, globes, or the like, to electric incandescent and other lamps." C BARTENSTEIN. Dated June 6th.

12,670. "Improvements in the production or generation of electrical currents." J. POPPER. Dated June 6th.

12,673. "An apparatus for trimming electrotype and other blocks." J. I. GIBSON. (W. C. Dalbey, United States.) Dated June 6th.

12,680. "Improvements relating to electric alternating current cable systems." F. CLOUTH. Dated June 6th. (*Complete.*)

12,699. "Improvements in or relating to electric transformers." J. J. BELLMAN and C. T. RITTENHOUSE. Dated June 7th. (*Complete.*)

12,731. "Improvements relating to electric telegraphs." A. MUIRHEAD. Dated June 7th.

12,754. "Improvements in apparatus for the generation and electrolytic application of electric currents." F. E. ELMORE. (J. O. S. Elmore, India.) Dated June 7th.

12,763 "Improvements in and relating to apparatus for electro-therapeutic purposes." W. P. THOMPSON. (A. Maggiorani, Italy.) Dated June 7th. (*Complete.*)

12,765. "Improvements in or relating to the electrolysis of liquids and apparatus therefor." W. P. THOMPSON. (M. Hazard-Flamand, France.) Dated June 7th.

12,774 "Improvements in electric railways." G. F. REDFERN. (B. J. Falk, United States.) Dated June 7th.

12,784. "Improvements in electrical rheostats and resistances." L. J. STEELE. Dated June 8th.

12,810. "Magnetic measuring instruments." J. RUSSELL. Dated June 8th.

12,815. "Improvements relating to electrical motors." R. C. JACKSON. Dated June 8th.

12,825. "Improvements in obtaining metals from their fused ores oxides, and salts by electrical action." J. B. DE ALZUGARAY. Dated June 8th.

12,829. "A new or improved apparatus for electrically signalling on railways" R. MESCHAMP. Dated June 8th. (*Complete.*)

12,839. "Improvements in electric glow lamp fittings." SIEMENS BROS. & Co., LTD. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated June 8th.

12,840. "Improvements in electric glow lamps." SIEMENS BROTHERS & Co., LIMITED. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated June 8th.

12,841. "Improvements in contact rings for electric glow lamps." SIEMENS BROTHERS & Co., LIMITED. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated June 8th.

12,855. "An electrical indicating apparatus for automatically denoting the position of ships' and other doors and for like purposes." G. HILL. Dated June 8th.

12,860. "Improvements in telegraphy by means of electric light." K. ZICKLER. Dated June 8th.

12,866. "Improvements in electrical circuit-controllers." H. H. LAKE. (N. Tesla, United States.) Dated June 8th. (*Complete.*)

12,877. "Improvements in electric arc lamps." P. SPIES and S. ROBERTS Dated June 9th.

12,690. "Improvements in the method of and means employed for connecting the guard wires of electric cables." R. BOSTOCK and F. A. CHEETHAM. Dated June 9th.

12,893. "Improvements in safety devices for electrical circuits." L. J. STEELE. Dated June 9th

12,897. "Pliable support for electric incandescence lamps or other light articles." J. DUGAILL. Dated June 9th.

12,925. "An improved device for holding and supporting telephone 'receivers' and for automatically operating the switch lever." A. BACK. Dated June 9th.

12,926 "Improvements in or relating to electric arc lamps." A. J. BOULT. (M. Baumer, Germany.) Dated June 9th.

12,929. "Improvements in or connected with telephones." F. W. GOLBY. (R C. Stempel, Germany.) Dated June 9th.

12,968. "A new or improved magnetic controlling device." H. EDMUNDS. Dated June 9th.

13,010. "Improvements in electric arc lamps." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (R. Fleming, United States.) Dated June 10th. (*Complete.*)

13,011. "Improvements in clutches for electric arc lamps." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (H. C. Spinney, United States.) Dated June 10th. (*Complete.*)

13,012. "Improvements in caps for enclosed electric arc lamps." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. E. Harthan, United States.) Dated June 10th. (*Complete.*)

13,020. "Improvements in construction of induction coils in detachable sections." W. J. LE COUTEUR. Dated June 10th.

13,021. "A combined portable manual-power dynamo and accumulator." W. J. LE COUTEUR. Dated June 10th.

13,037. "Improvements in electric glow lamps." THE SPIRAL GLOBE, LIMITED, and B. C. E. PARKER. Dated June 10th.

13,080. "Improved signal or alarm for tramcars, yachts, electric launches, and like purposes." A. H. WORMALD. Dated June 11th.

13,116. "Improvements in conductors for incandescent electric lamps." O. IMRAY. (Carl Auer von Welsbach, Austria.) Dated June 11th.

13,121. "Improvements in electrical accumulators." H. W. COBB. Dated June 11th.

13,157. "A new or improved apparatus or tool holder for carrying carbons or electrodes for use in electric welding, brazing, and the like purposes." G. W. DE TUNZELMANN. Dated June 11th.

13,144. "Improvements in apparatus for electrically controlling engines, electric-motors, and other machinery." W. H. HARFIELD. Dated June 11th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. **W. P. THOMPSON & Co., 322, High Holborn, W.C.**, *price, post free,* 9d. *(in stamps).*

1897.

19,118. "Improvements in dynamo-electric driving apparatus especially suitable for propelling vehicles." P. L. GOLDSCHMIDT. Dated August 18th, 1897. In this electric driving apparatus for motion of the armature, and of the field magnet is respectively transmitted directly to two shafts, in such a manner that the number of revolutions is reduced, in consequence of the relatively independent motion of the field magnet, and of the armature; so that intermediate and differential gearing can be dispensed with, and the shafts rendered independent of each other. 2 claims.

18,628. "Improvements in portable electric primary." C. H. COLE. Dated August 11th, 1897. This relates to those batteries where the electrodes may be immersed or removed from the exciting fluid by reversing the battery. The tubular carbon electrode is formed with circumferential corrugations and fitted with an end projecting platinum contact point. The cell is moulded entire, with one opening for placing and removing the zinc electrode and the exciting fluid. The carbon is fixed within one end of the cell as the latter is moulded; the rubber entering into the corrugations of the carbon and holding between an inner ledge and the cell end, and hermetically closing around the projecting platinum point. The cell is thus moulded with projecting bosses for the respective terminals. There is also a means for connecting the terminals and circuit connections. 2 claims.

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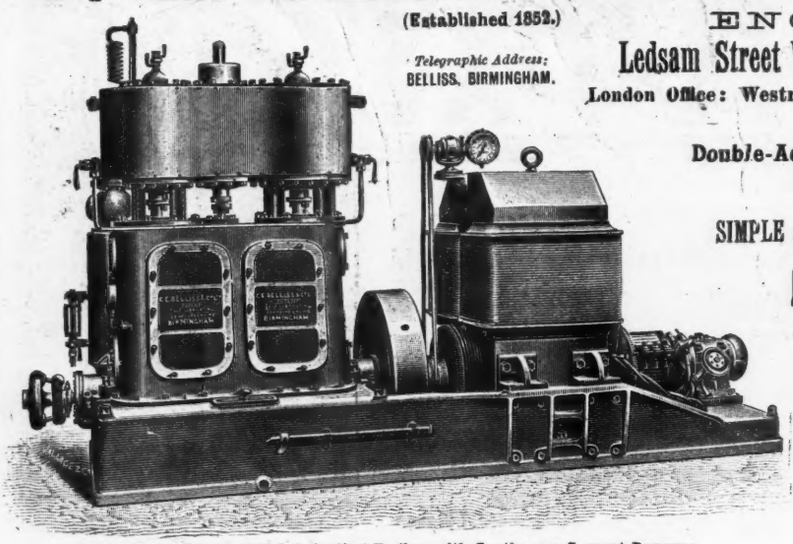

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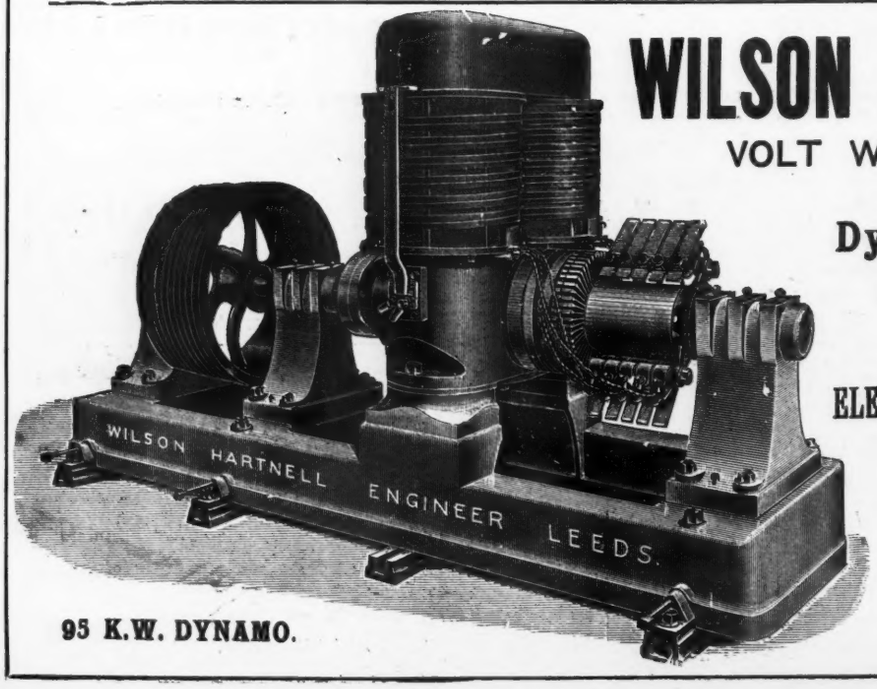

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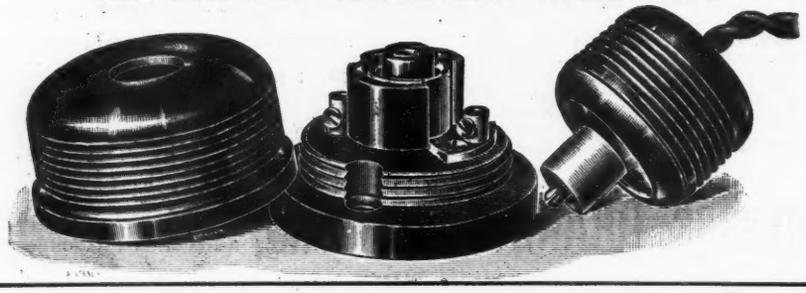

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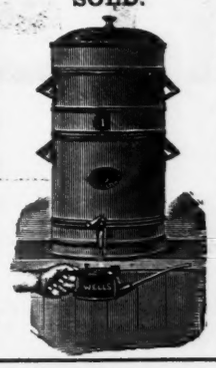

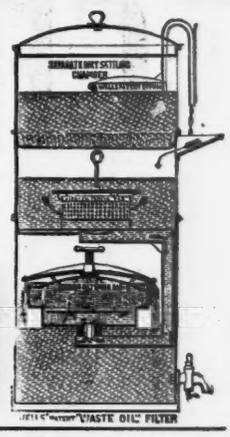

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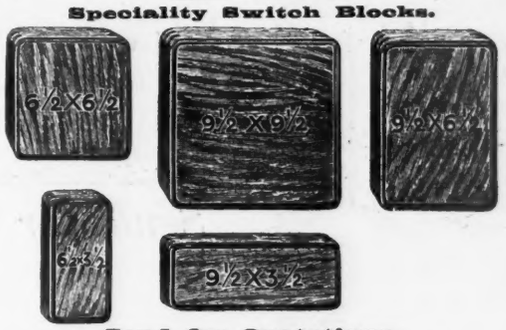

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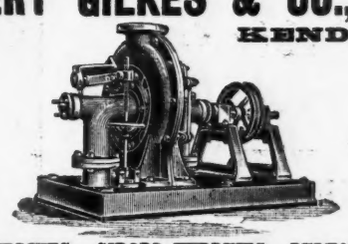

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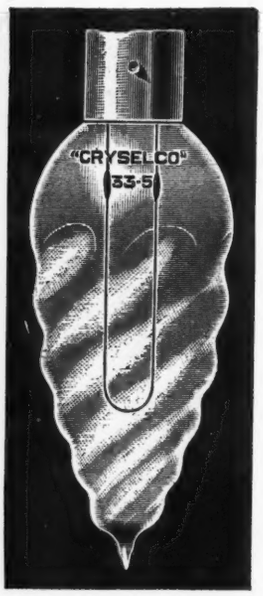

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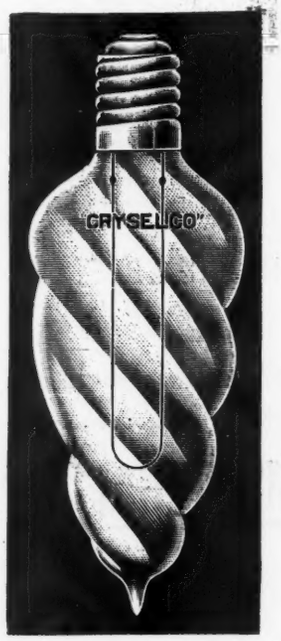

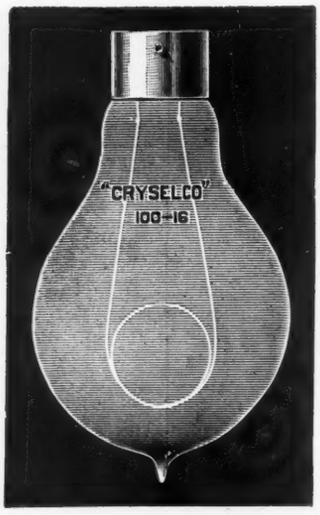

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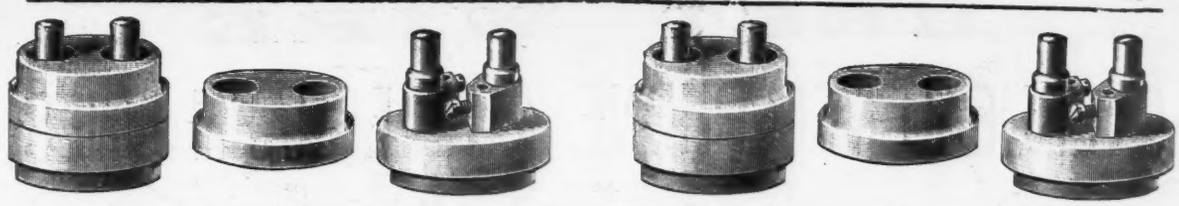

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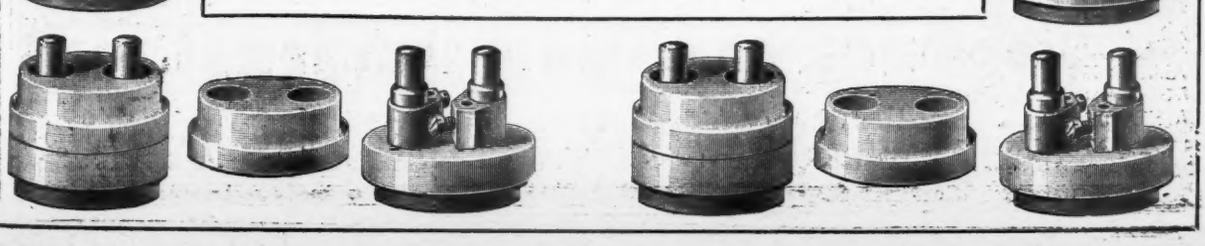

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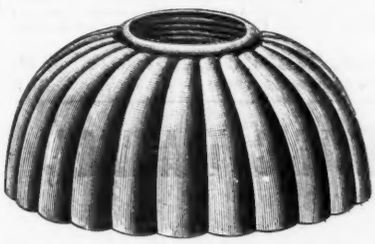

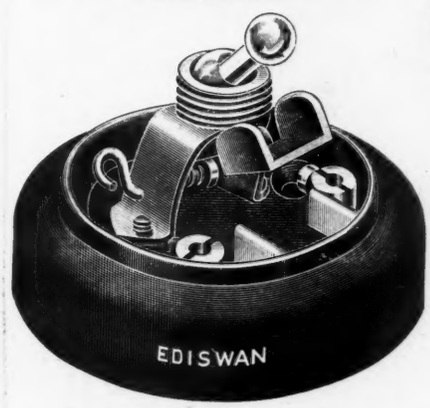

Fig. 907.

Price 1s. 9d. each.

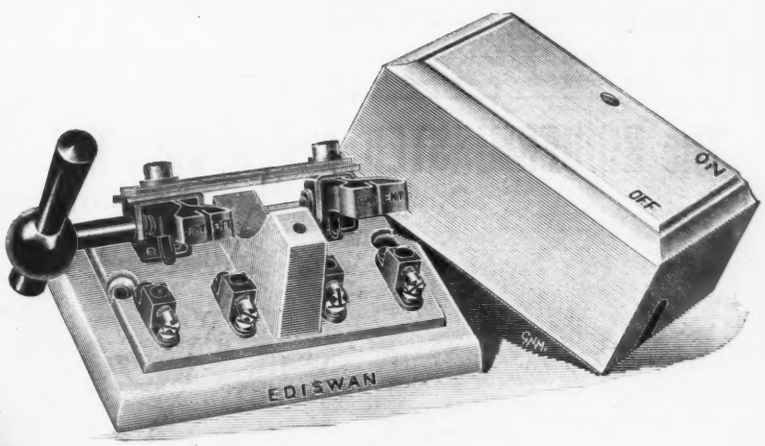

Fig. 1825.

	s.	d.
Fig. 1825.— 8 amperes	**7**	**6**
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Liberal Discounts.

Prompt Delivery.

Best Workmanship and Finish.

Fig. 920.

Price 1s. 6d. each.

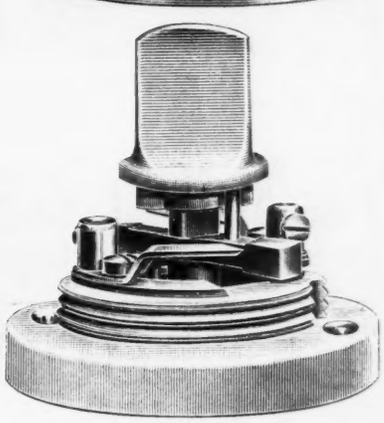

Fig. 700.

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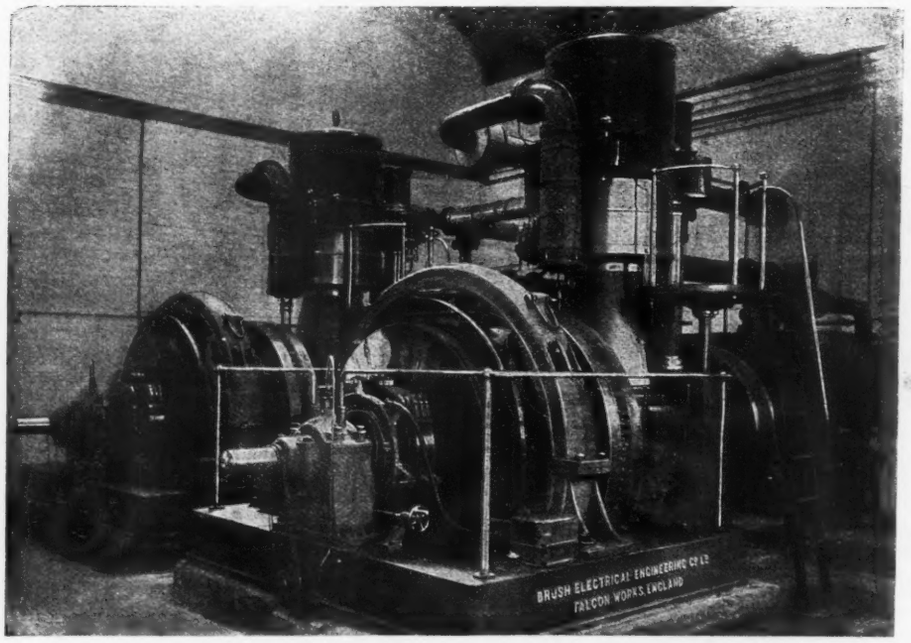

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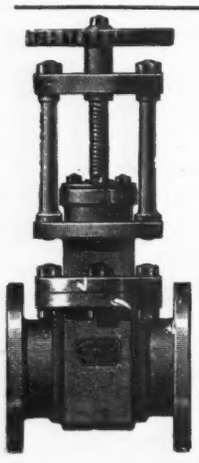

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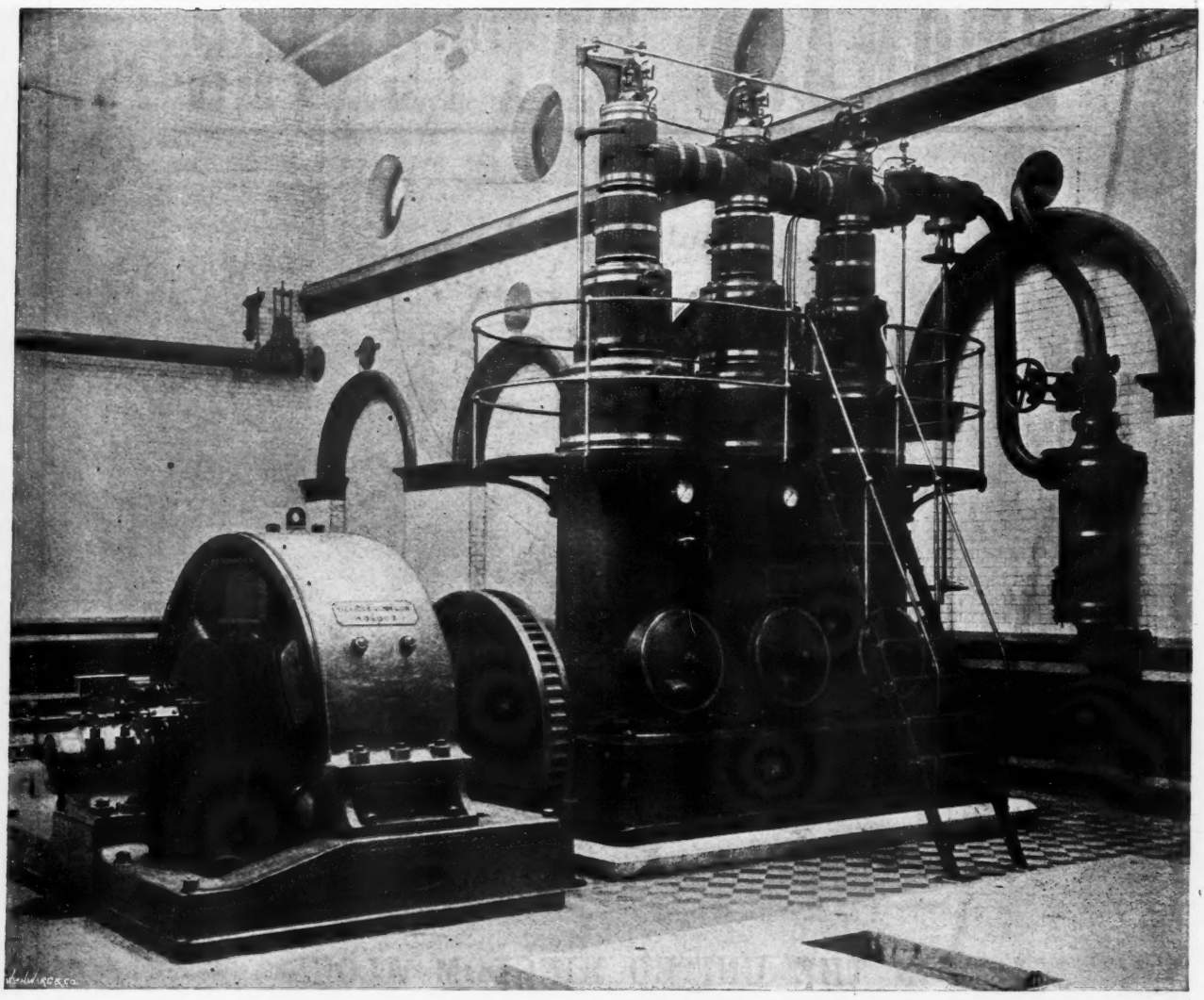

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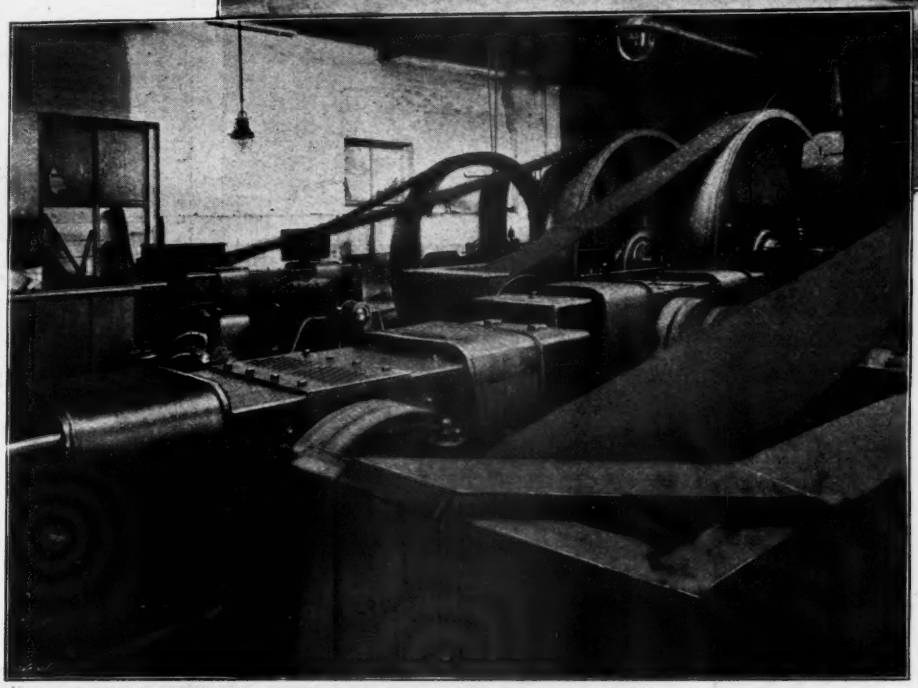

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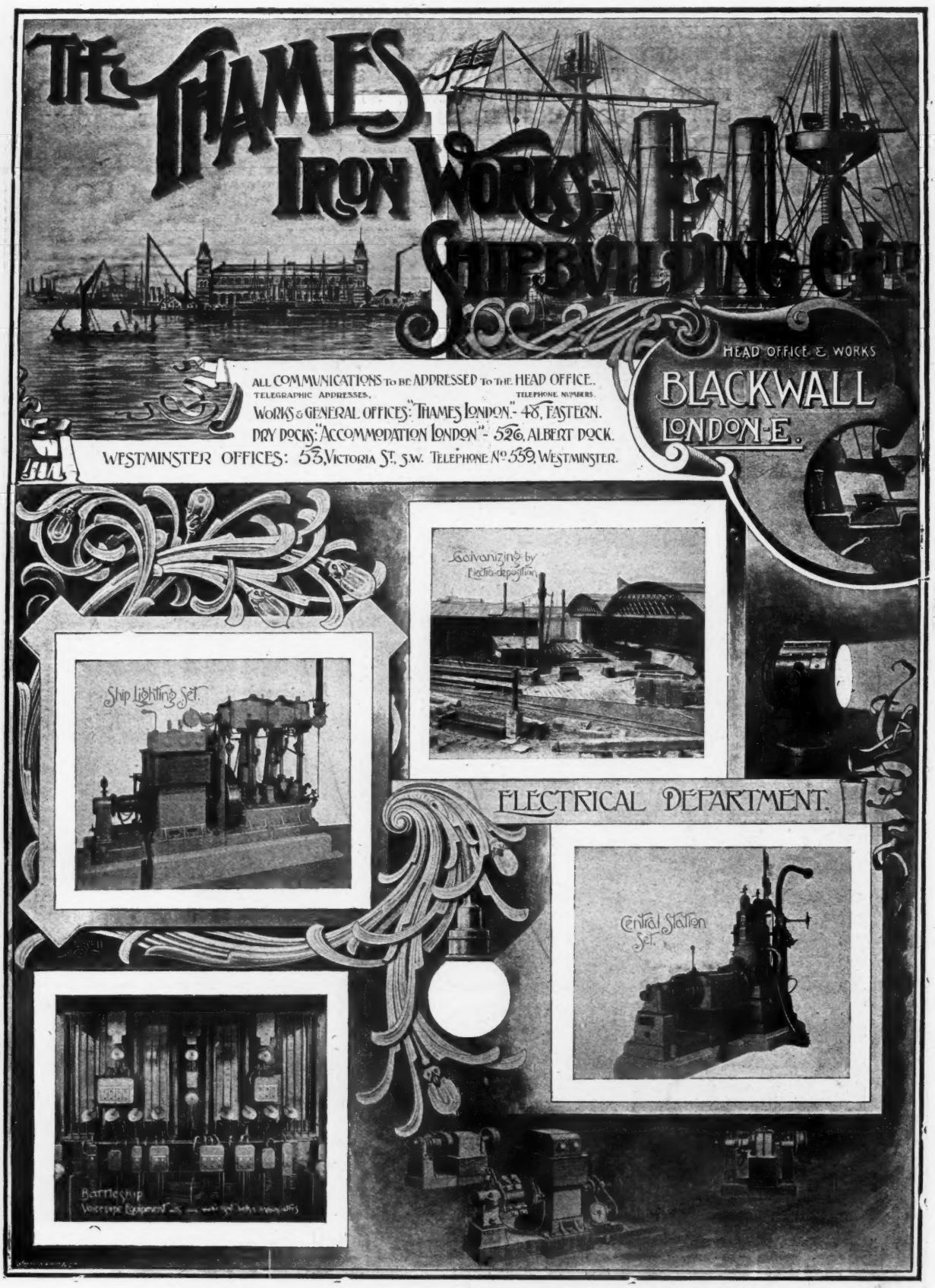
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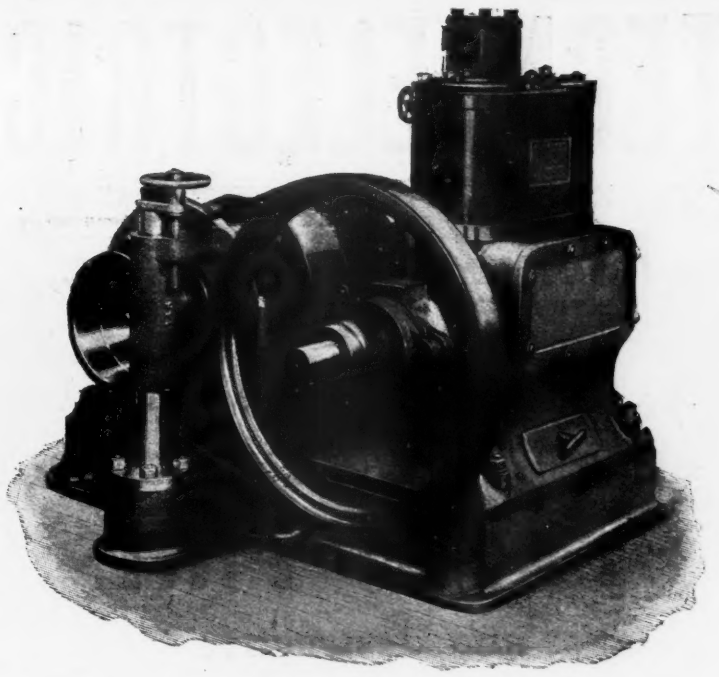
To meet the requirements of Shipbuilders and Bridgebuilders, Machines can be had with or without Electro-magnets for holding on, and arranged to work either with the motor and driller in combination or as separate machines connected by flexible or telescopic shafts.



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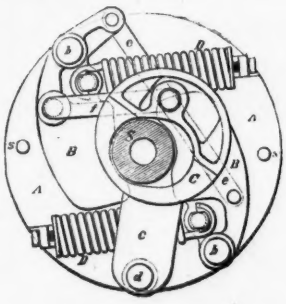
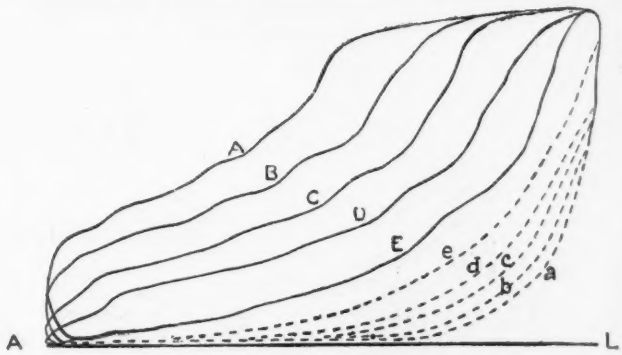
Conduce to DURABILITY and ECONOMY.

The above shows our 10″ × 8″ Simple "Sentinel" High Speed Engine driving dynamo by belt. It is running, **without holding-down bolts**, engine at 430, dynamo at 1,000 revolutions per minute, the result being **invisibility of band-wheel spokes** and **no vibration.**



The Crank Shaft Governor.
The bearing of this governor on steam econony is shown in our Engine Catalogue, No. 14.



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Showing distribution of steam at loads varying from 10 per cent. over rated load to *nil*. The latter shows small internal friction of engine and demonstrates its **High Mechanical Friction.**

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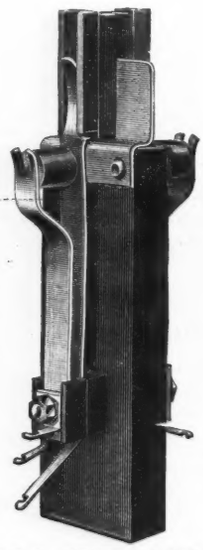

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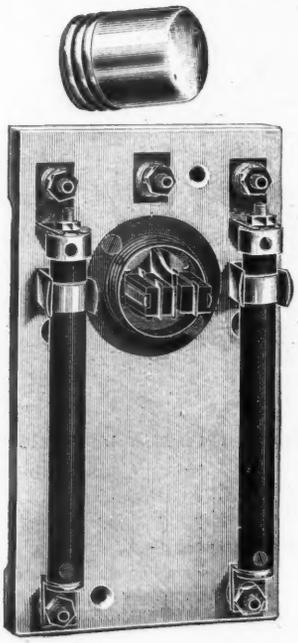

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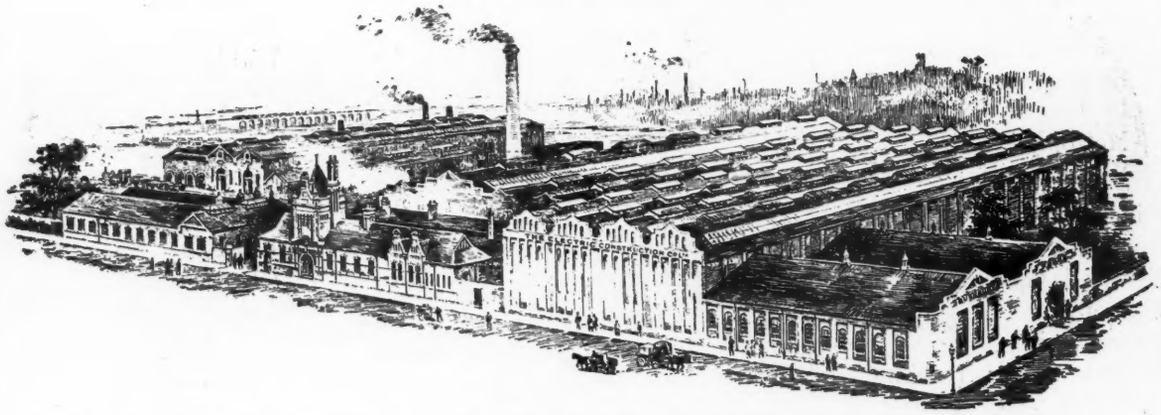

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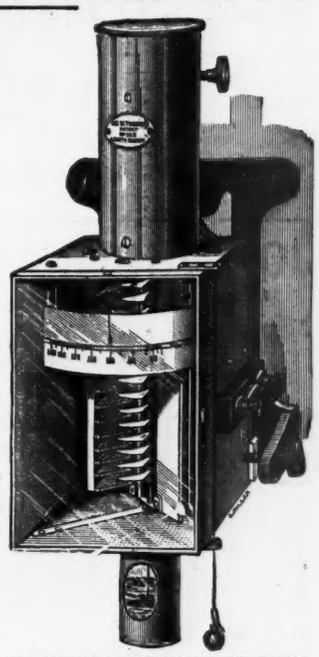

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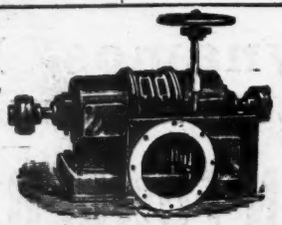

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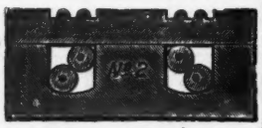

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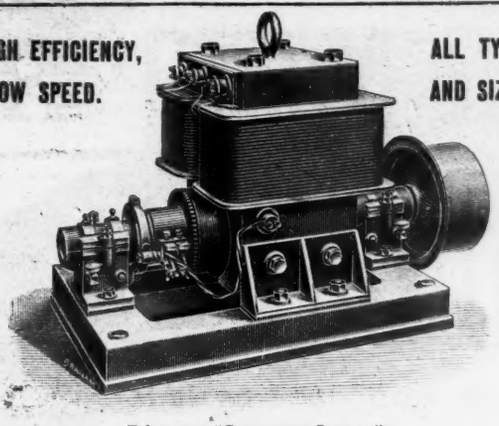

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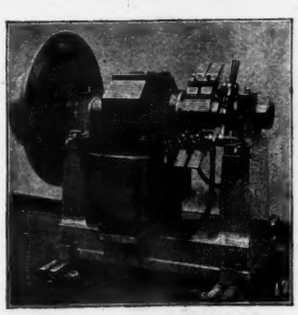

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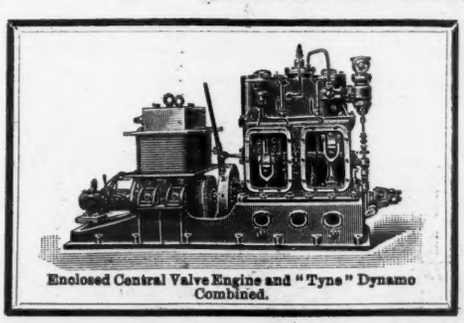

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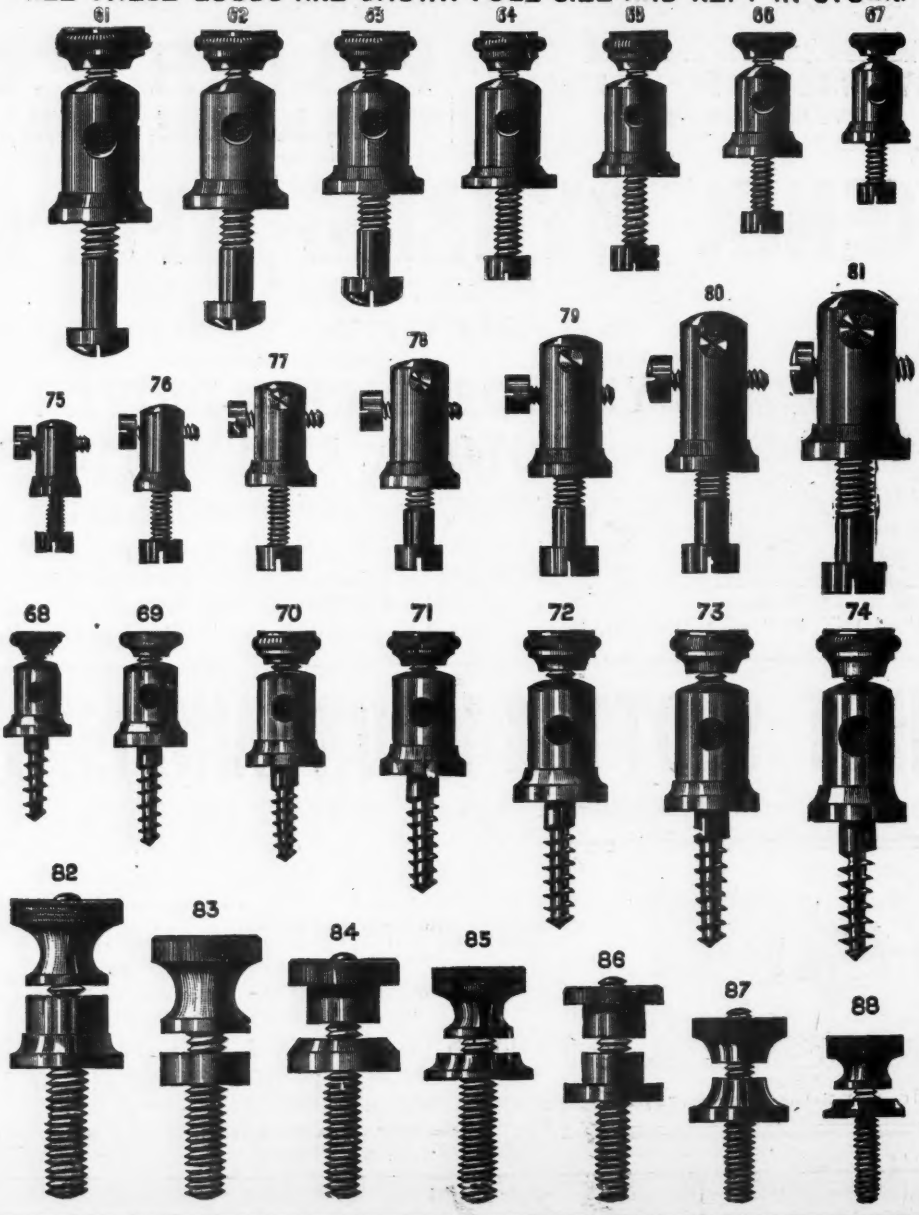

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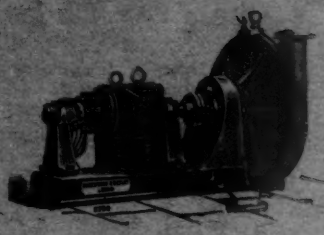

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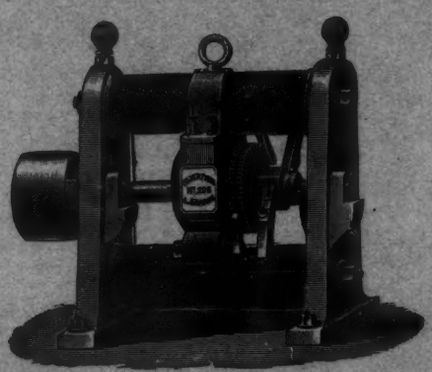

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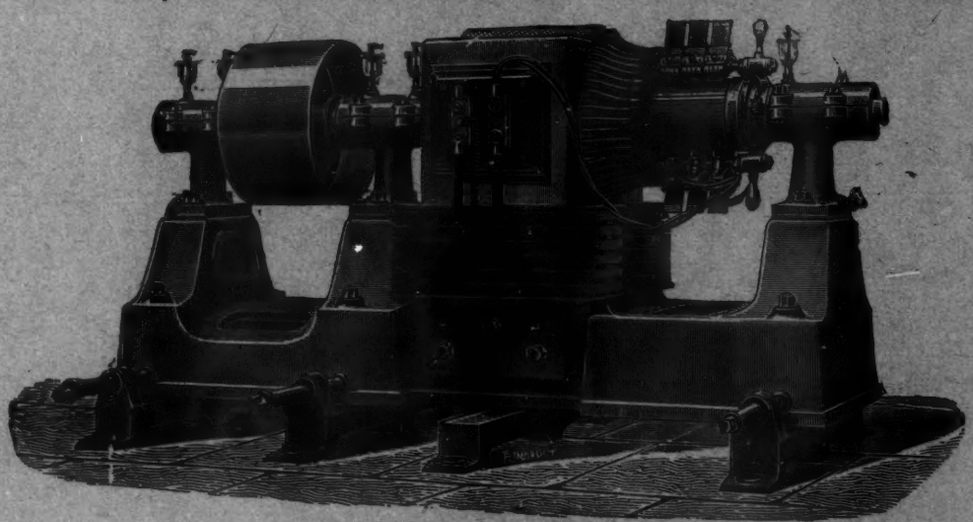

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